ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

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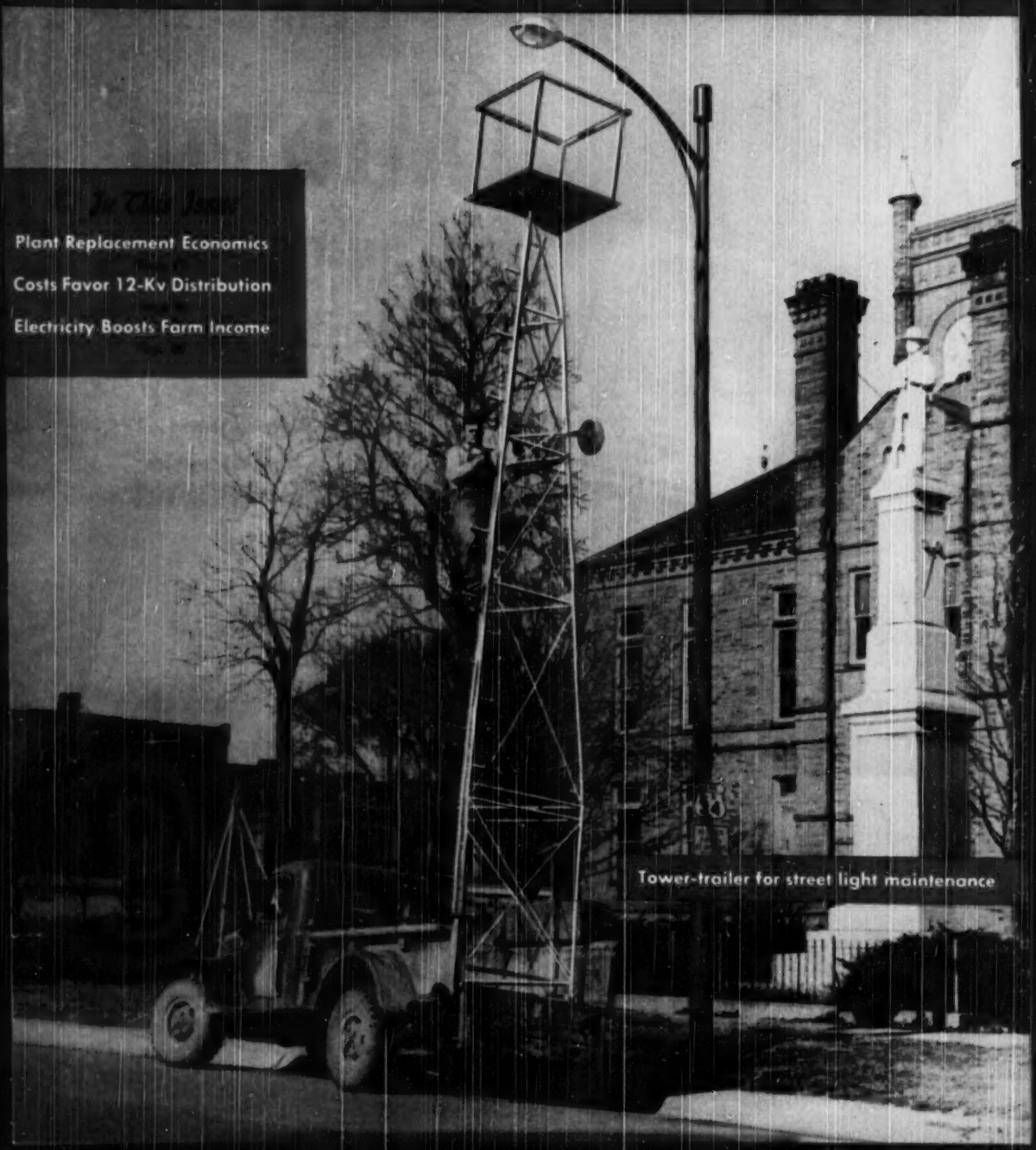
Plant Replacement Economics

Costs Favor 12-Kv Distribution

Electricity Boosts Farm Income



Tower-trailer for street light maintenance

Year After Year
You Can Count On

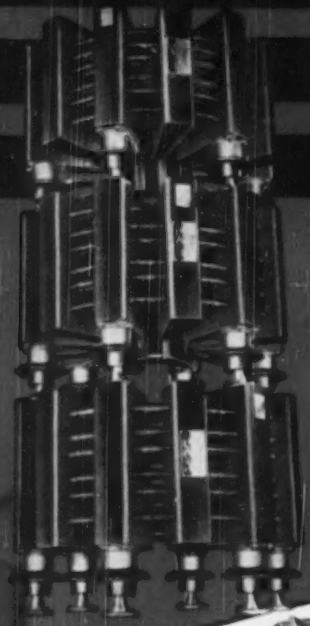
Dependable Circuit Protection

WITH

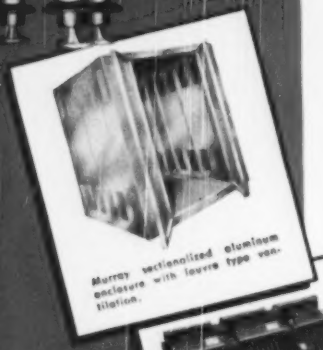
Murray

CAST-IN-CONCRETE
Current-Limiting Reactors

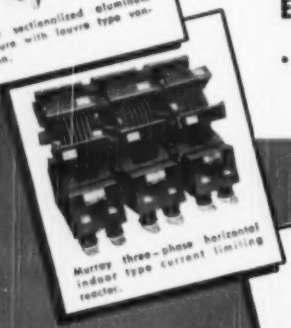
Engineered to your specifications...
...for indoor or outdoor service.



Typical Murray three-phase vertical outdoor type cast-in-concrete current limiting reactor.



Murray sectionalized aluminum enclosure with louvre type ventilation.



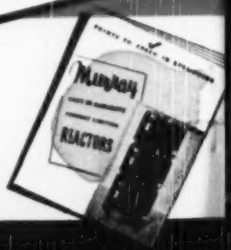
Murray three-phase horizontal indoor type current limiting reactor.

Murray single-phase completely cast-in-concrete vertical outdoor type reactor.

Murray pole top reactor.

Feeder
Generator
Motor Starting
Neutral Grounding
Transformer Equalizing
Special Purpose
Station Tie
Bus Tie
Shunt
} Reactors

To help you give detailed information on reactors for your individual application, this comprehensive folder has been especially prepared. It provides a reliable guide to points to check in specifying all types of cast-in-concrete current limiting reactors. Write Murray for your copy today.



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MANUFACTURING CORPORATION

50 Years of Service to the Electrical Industry

1250 ATLANTIC AVENUE • BROOKLYN 16, NEW YORK

SERVICE ENTRANCE & METER EQUIPMENT • MAGNETIC CIRCUIT BREAKERS
SWITCHES • CURRENT LIMITING REACTORS • CROWS NEST AERIAL LADDERS

OF PERSONAL INTEREST

WHAT ABOUT 1951?

Electrical World's editors (with the help of the McGraw-Hill Department of Economics) have now put the final touches on our second annual forecast issue, coming Sep. 11. One of our jobs has been to check up on last year's forecast, just to see how good we were at crystal-gazing. And if you'll pardon our pride, the predictions were very good indeed.

For example, last year's forecast said this about business in 1950:

"Industrial production, as measured by the Federal Reserve index, may well be in the 195-200 range."

Right now the production index is estimated at 200 and it's rising. We said a gain of 10% in power sales was clearly possible. Now it appears that 13% would have been more accurate.

Some industry authorities considered us over-optimistic on many of the predictions we made in last year's forecast. As it turned out though, the only places where we were wrong, and not far wrong at that, were **under**-statements.

We said 1950 would be a "year of normal prosperity". And so it was until recently. Now, of course, we've passed "normal prosperity" and business can only be called a boom. Buying and production are going like fire wagons, but this is due to Korea and the military committments we must make. We'll admit our editors did **not** predict Korea. Neither did anybody else.

As for the future: We cannot attempt to gage the course of conflict. This much seems sure: The U. S. is rearming on a major scale, involving $15 billions a year of additional national spending. The path of business must be upward. For educated guesses look closely at EW for Sep. 11.

THE EDITORS

ELECTRICAL WORLD

Published for 76 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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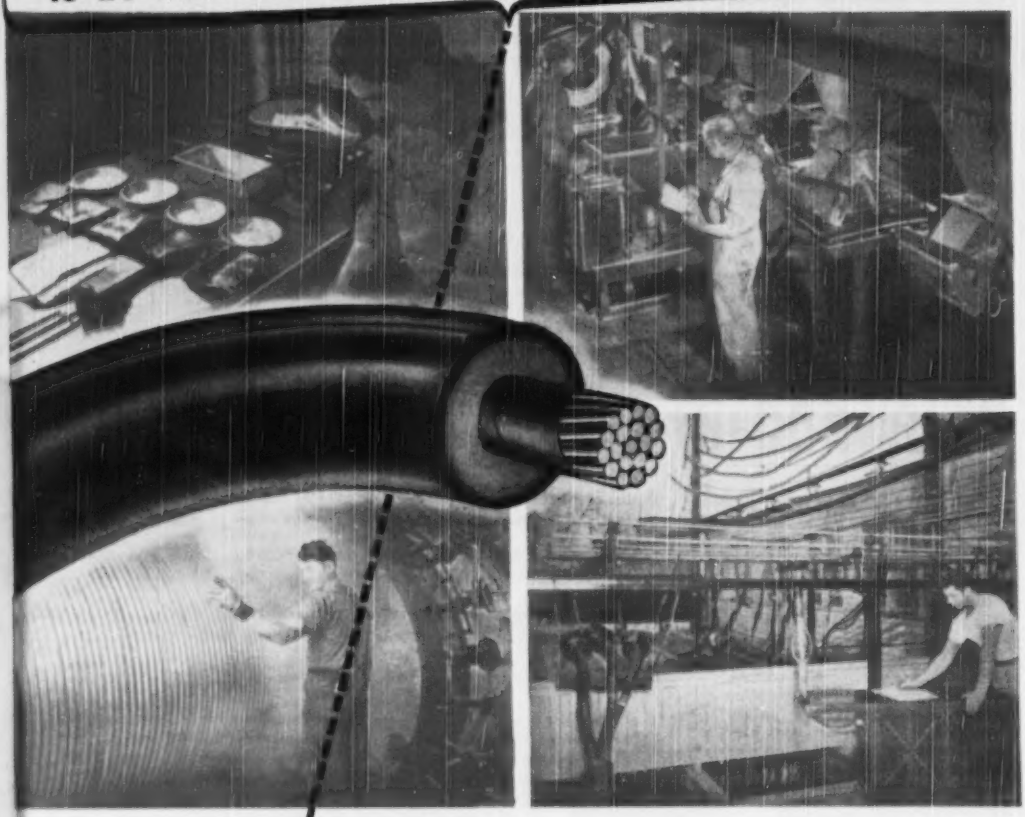
a NEOPRENE SHEATH is no better than its COMPOUNDING*



"Too much stress cannot be laid on the important fact that the best neoprene products are produced by those manufacturers who are skilled in the art of compounding neoprene."

E. I. du Pont de Nemours & Company, Inc.

Neoprene is a raw material. With neoprene it is possible to make a cable sheath that combines resistance to weather, oils, chemicals, flame and ozone – thus increasing the life and versatility of an electrical cable. But the *use* of neoprene alone does not guarantee all its advantages.

The performance of a neoprene sheath depends on experienced compounding... the use of ingredients that give optimum characteristics and yet assure secure bonding to the insulation... the skill and technique of processing, applying and vulcanizing.

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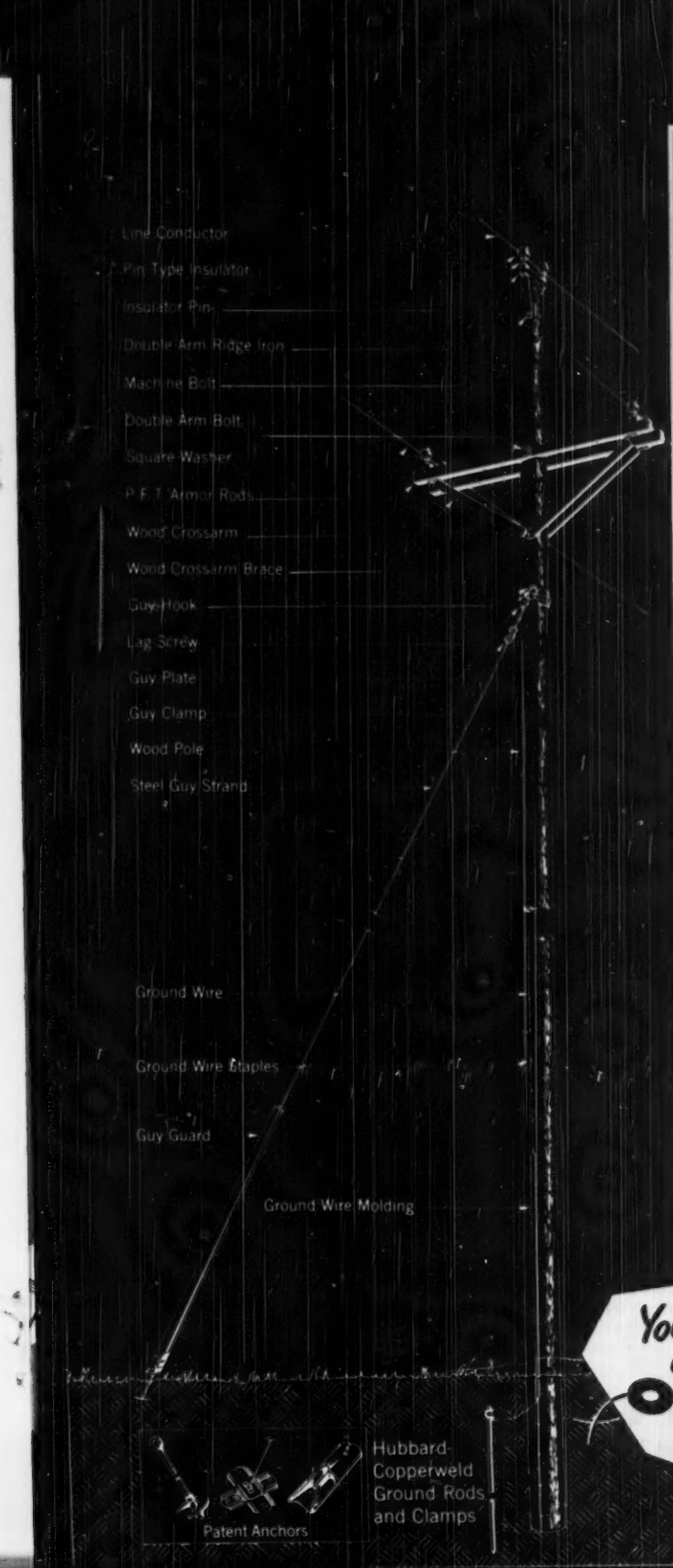
Remember, it is necessary to compound the raw neoprene material with other ingredients in order to use it. It's the finished compound that counts. And – in these days of high installation and maintenance costs – the outstanding performance of an Okoprene sheath is more important than ever to *true cable economy*. The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

8100

OKONITE insulated wires and cables



From a single near-by source

everything from the bottom of the hole to the top of the pole

Why spend time shopping around for pole-line equipment and supplies? From near-by Graybar you can fill all your requirements with just one order—and be sure you're getting dependable items. By ordering all your pole-line needs from this single source, you save time and paper-work expense. You get the products of the leading manufacturers of poles, crossarms, insulators, hardware, strand, line trucks and tools.

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When you call on Graybar, for supplies or for information, your needs are understood and accurately met. That's because Graybar has been familiar with pole-line requirements ever since the first lines went up. Experienced Graybar Outside Construction Specialists are on call to help you solve unusual problems in the planning of any pole-line or underground project. *Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.*

5035

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Via GraybaR

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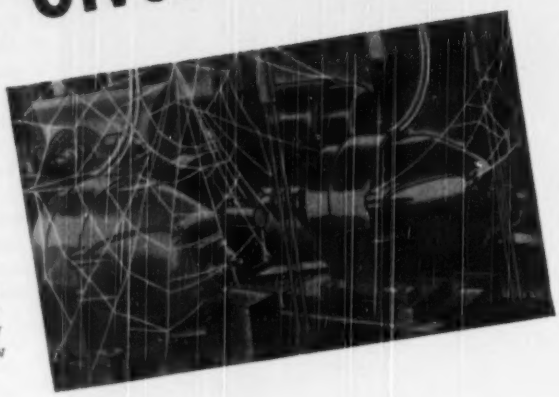
NEW! IRV-O-FLEX® TUBING Gives Longer Life!

Longer Life On the Job!

The longer-lasting flexibility of Irv-O-Flex tubing enhances the durability of your products. Disassembly, servicing, and reassembly are greatly simplified with this new longer-life tubing!



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TRADE REG. U.S. PAT. OFF. MARK

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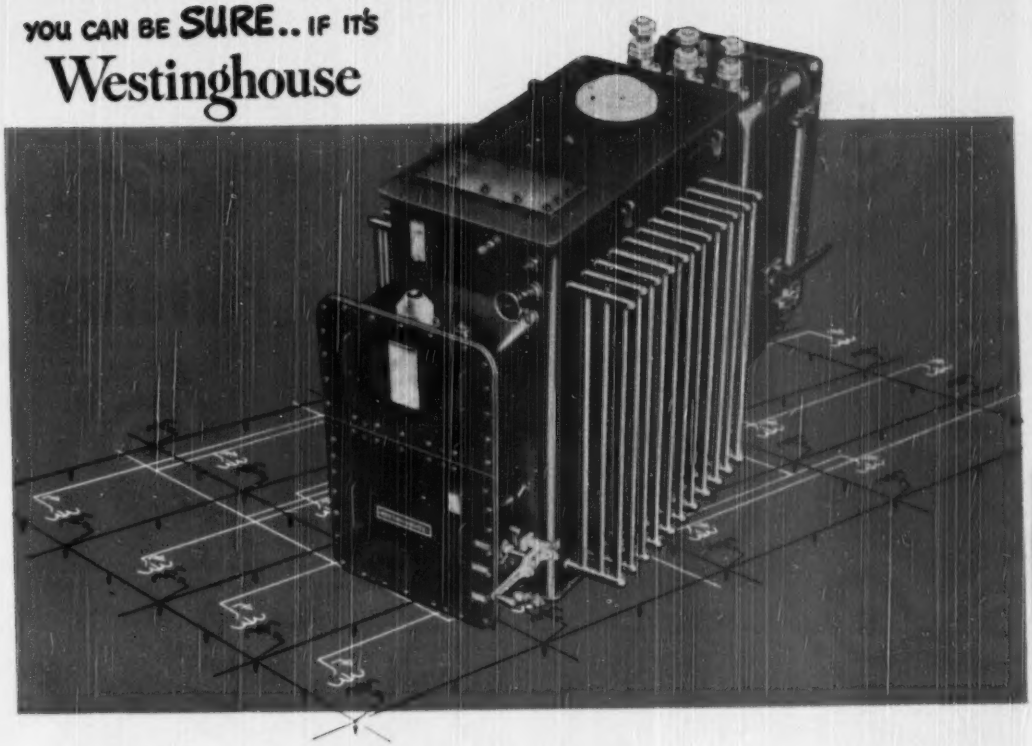

MOST ECONOMICAL . . .
for General Network Use

The *original* network transformer in its most highly developed form, this standardized Westinghouse Network Transformer is most economical for general use . . . especially valuable where space is at a premium. Available with either oil or Inerteen ®, a non-inflamable insulating and cooling liquid.

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Now There is a Westinghouse Transformer specifically designed to answer each of your network problems. In addition to LIQUID-FILLED units, there are "ASL" VENTILATED DRY-TYPES, ideal for indoor service; SEALED DRY-TYPES, the safest transformers ever built; and TYPE "S", pole-mounted to bring network advantages to less dense areas. Standardized construction provides lower initial cost and lower installed cost, too. Special hook-up problems are eliminated.

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LINE UP for low-cost steam...
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Recirculation of fines within the mill gives repeated, quick-drying contact with large masses of heated air and metal . . . produces proper fineness at all loads, even with coal as wet as it can get. Fines are classified in the mill.

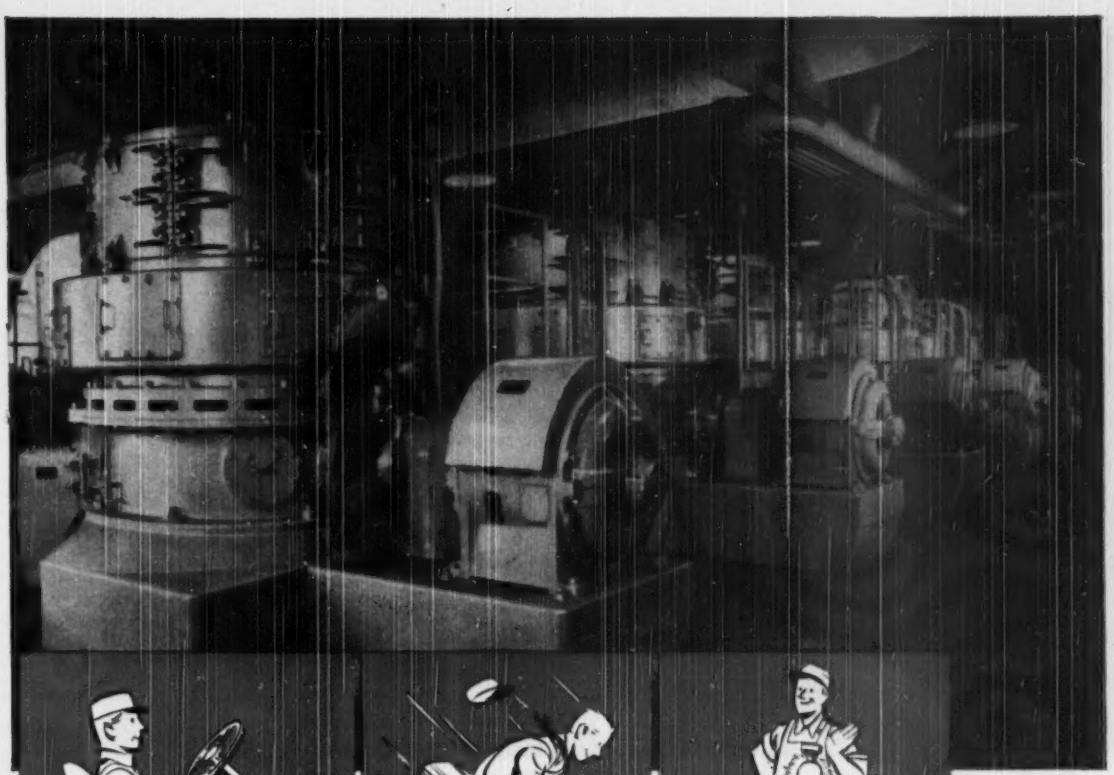
UNIFORM PERFORMANCE REGARDLESS OF WEAR

Balls and grinding rings wear together . . . assure uniform fineness regardless of attrition of the grinding elements . . . fineness automatically increases at reduced loads.

BLOWS CLEAN AIR – SAVES WEAR AND TEAR

Unique in pressurized operation, the Type E Pulverizer requires remarkably little maintenance of the primary fan, because it blows only clean air . . . is not subject to the damaging abrasion of entrained particles.

New Bulletin G-57 illustrates and describes the design, construction, operating and maintenance features of the Type E Pulverizer. Write: The Babcock & Wilcox Company, 85 Liberty Street, New York 6, New York.



ONE-POINT VARIABLE FUEL-AIR CONTROL

Like the accelerator on your automobile . . . assures proper coal-to-air mixture . . . produces desired rate of steam generation over a wide range with coal conditions suitable for sustained high combustion efficiency.

LOW POWER CONSUMPTION

Ball-and-ring grinding, anti-friction bearings, pressure lubrication, and automatic rejection of ungrindable materials make possible high output with minimum power demand.

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Availability and maintenance economy beyond today's most exacting requirements are proved in over 1300 Type E Pulverizer installations.

Helping Industry Cut Steam Costs Since 1867

BABCOCK & WILCOX

G-5047

Puzzle for experts

There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

Grinnell integrates the many factors in this complex, highly technical assignment in one organization of specialists. Major economies result from this single responsibility which includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

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AN INSULATOR SUCCESS STORY BUILT ON INSULATOR FAILURES

If conventional transmission insulators gave no trouble, there'd be no need for a better insulator design. But the fact is that a pin-type transmission insulator is a device which leaves considerable to be desired in the way of mechanical and electrical performance.

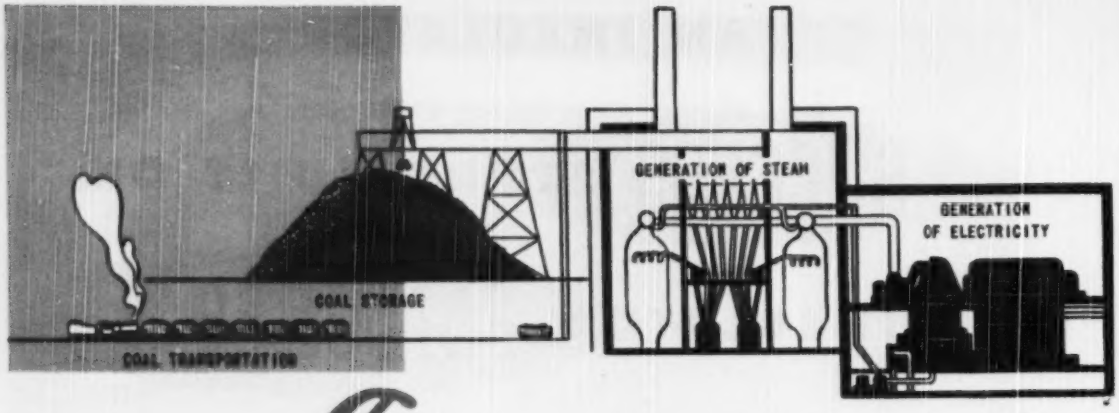
If you think that pin-type transmission insulators on your systems are serving "about as well as could be expected," you owe it to your company to take a good long careful look at your own maintenance records. We bet you'll find that the total annual cost for pin-type insulator replacements adds up to a mighty important piece of money.

The success of the Lapp Line Post insulator is built squarely on the fact that so many conventional pin-type insulators do fail, and the fact that use of this *better* insulator does cut maintenance cost in insulator replacements to a small fraction of that for conventional insulators.

We invite you to consider Lapp Line Posts as your transmission insulator standard—on this straight dollars-and-cents basis.

Lapp

LAPP INSULATOR COMPANY INC., LEROY, NEW YORK

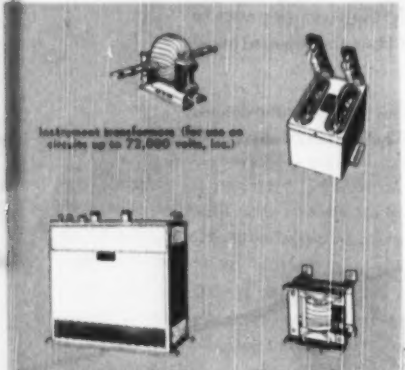


Standard

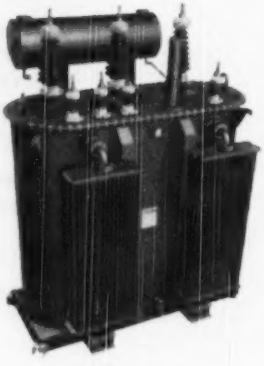
TRADE MARK ®

TRANSFORMERS

RELIABLE LINKS IN THE CHAIN OF DEPENDABLE ELECTRICAL SERVICE

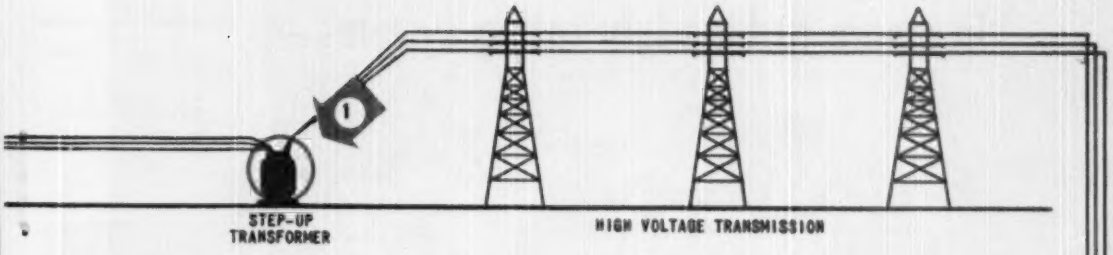

Instrument transformers (for use on circuits up to 72,000 volts, inc.)
Dry type (up to 1000 KVA and max. voltage ratings of 7200)
Control transformers (compound filled or open type)

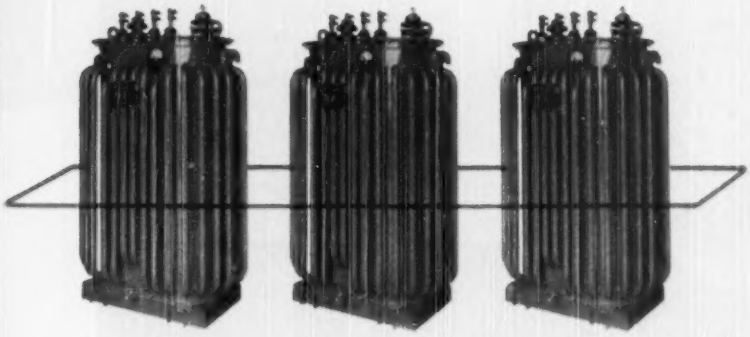
The Electrical Industry can depend on STANDARD to supply transformers for ANY APPLICATION in the production, transmission and distribution of electric power.



1 Power transformers, for your specific transmission requirements, whether special or standard, are available quickly, as STANDARD specializes in made-to-order transformers.

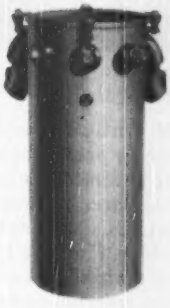
It takes no longer to get a specially designed transformer than it does a stock type.





2 As in all of STANDARD transformers, substation types are designed to conform to industry standards. A complete range of sizes and types is built to the exact engineering specifications of the user. Space-saving and other economies are realized when you take advantage of STANDARD individualized engineering.

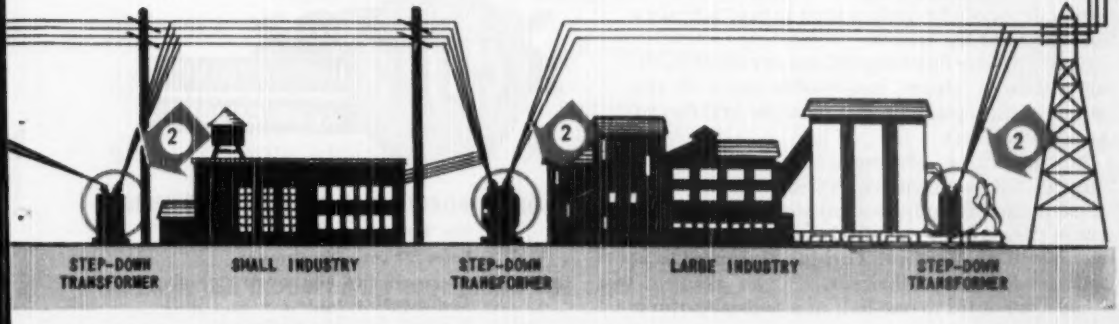
3 Lower installation costs and less maintenance are experienced by utilities that depend on STANDARD for pole type distribution transformers. Rural, urban and commercial services are economically maintained when STANDARD transformers are installed. Accessory protective devices may be selected to meet your individual standard. Every possible need, from power station to consumer, is better met through STANDARD transformers . . . specialists for a quarter century. Write for literature.



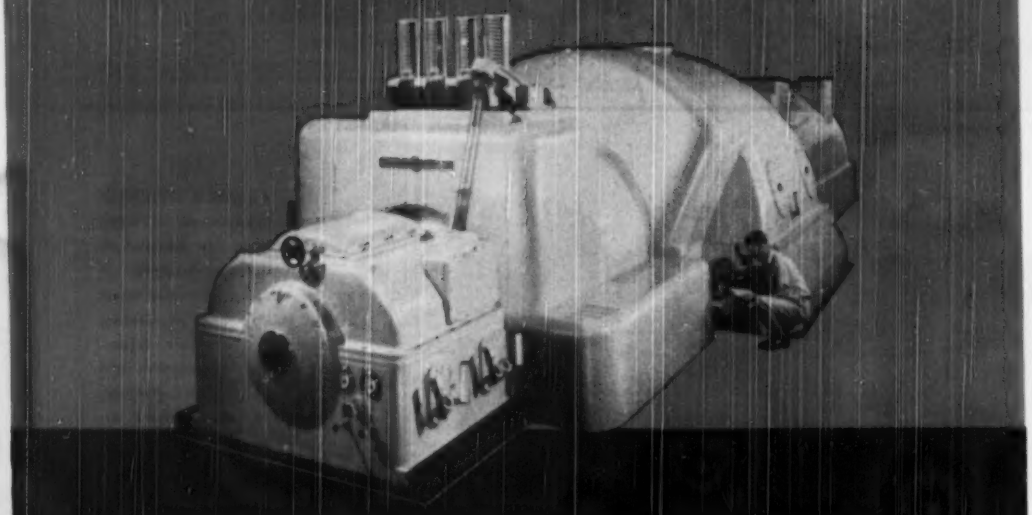
OFFICES IN PRINCIPAL CITIES

THE STANDARD TRANSFORMER CO.

WARREN · OHIO



Now—SURE PROTECTION AGAINST RUST in steam turbine lubricating systems—



GULF TURBINE FLUSHING OIL

Now—Gulf Turbine Flushing Oil has been further fortified to provide an even more effective rust preventive film! Now you can be sure that all oil bathed surfaces in your new turbine lubricating system are completely protected!

Gulf Turbine Flushing Oil has highly preferential wetting characteristics — displaces water quickly on the internal surfaces of the lubricating system. It should be used as soon as practical after installation of the system.

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An important advantage of Gulf Turbine Flushing Oil over other types (such as certain solvents) is that the undrained portion in the turbine system does not impair the lubricating value of the turbine oil. For Gulf Turbine Flushing Oil is itself a satisfactory lubricant.

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Located in principal cities and towns throughout Gulf's marketing territory

VOLTAGE
15,000 Volts (110 KV. B. I. L.)
For 2.3 to 13.8 KV. Service
CURRENT
60, 100, 140, 200, and 250 Amperes
MINIMUM TRIPPING CURRENT
Adjustable from 175% to 250%
of Current Rating
INTERRUPTING CAPACITIES
Up to 20 Times Current Rating

CHECK the FACTS

STOP *unnecessary fuse blowing*

R&IE

Type MB

Automatic CIRCUIT RECLOSER

60 to 250 Amperes

1. a. PREVENTS UNNECESSARY BLOWING OF FUSES
   The first or instantaneous trip opens the circuit before fuses can blow or be damaged.
   b. PREVENTS DAMAGE TO WIRES AND EQUIPMENT
   Destructive arcs are extinguished before insulated wire can be burned down or seriously weakened. Tests show No 4 covered copper wire will be burned down in 4 cycles at 1500 amperes.
2. COORDINATES WITH SECONDARY FUSES
   Several different size fuses can be protected with one Recloser.
3. INVERSE TIME-CURRENT CHARACTERISTICS
   Consistent mechanical timing — free from temperature error.
4. COORDINATES WITH PRIMARY FUSES
   Permits normal fusing for selective clearing of overloads and short circuits.
5. SELECTS WITH SUBSTATION OVERCURRENT RELAYS

Time Current Curves shown in Bulletin 1371A. Write for a copy.

I-T-E R&IE

RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.
AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA — EASTERN POWER DEVICES LIMITED, TORONTO

The Quick List

CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS

DISCONNECTING SWITCHES INDOOR AND OUTDOOR

HORN GAP SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC RECLOSING EQUIPMENT

METAL CUBICLES

TESTING DEVICES

Service Restored

faster than ever after ice storm . . .

Ice storms are a utility's nightmare. Recently, the Missouri Public Service Corporation had a beauty on its hands. Driven by high velocity winds, heavy sleet lashed trees and roads, coated them with 6 to 8 inches of ice, pulled down hundreds of miles of line in the 17-county service area.

Thanks to *instant communication* made possible by General Electric 2-way radio in line trucks and supervisors' cars, service was restored at least 3 to 4 days earlier than would have been possible without the use of radio, according to officials at company headquarters in Warrensburg.

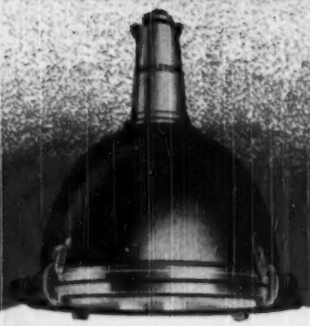
Utilities in every state use G-E 2-way radio to coordinate planned interruptions, to save manhours, truck hours, time on outages. Let our engineers study your communication problem, too—there's no obligation. Write: *General Electric Company, Section 1980-28, Electronics Park, Syracuse, N. Y.*

YOU BE THE JUDGE — CHECK THESE ADVANTAGES

Equipment Features	General Electric	Manufacturer A	Manufacturer B
Triple-Tuned Transformers (high selectivity with fewer tubes)	Yes	No	No
At Least 2 Watts Peak Audio Output	Yes	No	No
Instantaneous Modulation Limiting	Yes	Yes	No
Number of Tubes	18	26	22
Cost per Set of Tubes	$24.50	$50.16	$31.79
Spurious Radiation at any frequency	65 db	60 db in the band only	60 db
Cable Junction Box	Not Required	Required	Not Required
Key Lock for Protection of Every Unit	Yes	Optional at Extra Cost	Not Available
Microphone Quick Release Plug	Yes	Not Available	Not Available
20 kc & 40 kc Receiver Selectivity	Yes	No	No
Two-Unit Design for Maximum Mounting Flexibility	Yes	No	No

You can put your confidence in—

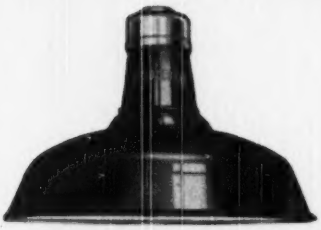
GENERAL ELECTRIC



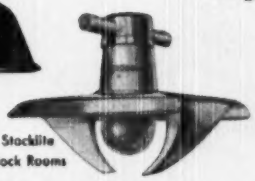
Industrilite High Mounting Fixture

GOOD LIGHT...

Industry's Most Essential Production Tool!



Standard Dome Reflector



The Stocklite
for Stock Rooms

● When you plan industrial lighting with Appleton Equipment the result is a finely coordinated system that paves the way for top worker efficiency, better production. That's because Appleton fixtures are scientifically designed to provide the *right light*, without uncomfortable glare, troublesome contrast or shadow. Products of nearly half a century of experience, expert engineering and unequalled manufacturing facilities, Appleton Fixtures provide maximum illuminating efficiency at minimum installation, service and operating expense. Appleton Lighting Fixtures are available in the exact type and size for every industrial requirement—including hazardous locations—whether indoors or out. Appleton's skilled illuminating engineers are ready to help you solve your specific lighting problems. For the finest in lighting equipment, specify Appleton—Standard for Better Lighting.

APPLETON LIGHTING EQUIPMENT

The EFU—First and Still Finest
Explosion-Proof Lighting Fixture

Standlite — for Filling Stations, Parking Areas

SOLD THROUGH ELECTRICAL WHOLESALERS

APPLETON ELECTRIC COMPANY

1703 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 50 Church Street • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 227 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA 724 Boulevard, N. E. • BIRMINGHAM, 429 Brown-Marx Bldg. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 East Pleasant Street • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street • CINCINNATI, 626 Broadway • HOUSTON, 738 M. & M. Bldg. • HAVANA, Cuba, Malecon No. 9

Resident Representatives: Dallas, Indianapolis, Kansas City, Orlando, Milwaukee, New Orleans, Seattle

Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

APPLETON

CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

"Now we restore service faster...thanks to FWD"

"Sure, trouble comes with bad weather . . . but bad weather doesn't slow up our FWDs"

"Our teamwork improved . . . we picked an FWD matched combination of truck and equipment to fit our job"

"Our FWDs last longer because there's less strain . . . both load and power are properly distributed"

Today's trend to FWD is due to this growing realization:

A utility's all-season performance on maintenance and construction is materially influenced by the *type of vehicle* employed!

It is common knowledge that no other truck can equal FWD when challenged by mud, sand, snow, ice, grades and off-the-road work. But, utilities discover additional dollar-advantages in also using FWD for normal, routine service. These *overall* FWD superiorities are significant assets throughout the economics and public relations of a utility.

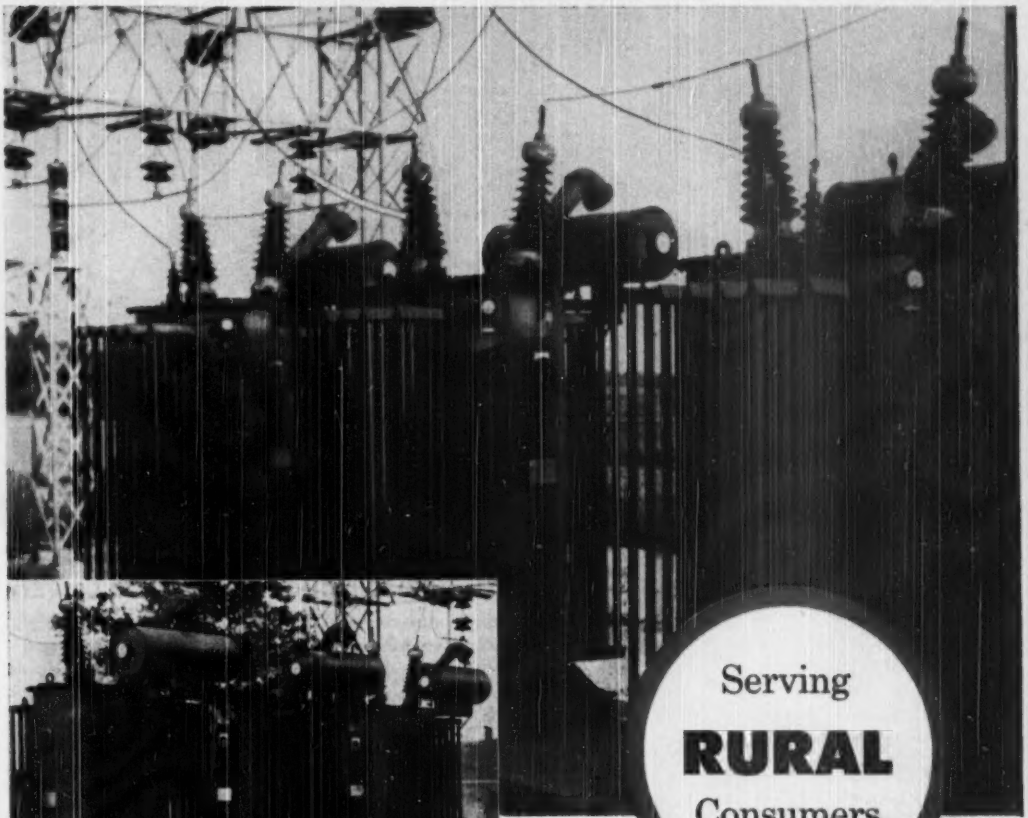
GET FULL FACTS on 38 standardized FWD motorized units. Each combines truck and equipment into one complete, easy-to-buy package — matched to your particular needs. One central responsibility for all equipment. See Graybar or write FWD direct.

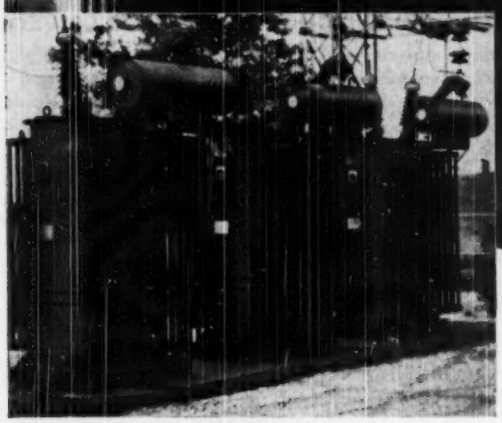
THE FOUR WHEEL DRIVE AUTO CO.
Clintonville, Wisconsin • *Canadian Factory:* Kitchener, Ont.
World-Wide Sales and Service

Distributed by GRAYBAR

America's Foremost Heavy-Duty Truck

Uptegraff POWER Transformers





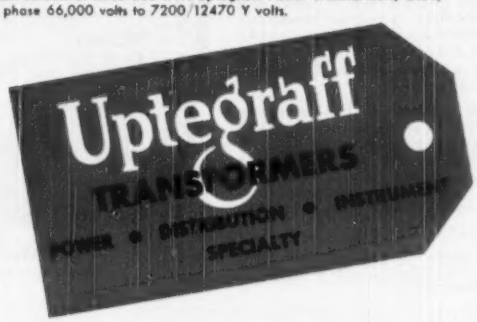
● Two views of a 2500 KVA substation, serving rural consumers. The installation consists of three 833 KVA Uptegraff Power Transformers, OISC, single phase 66,000 volts to 7200/12470 Y volts.

Serving **RURAL** Consumers

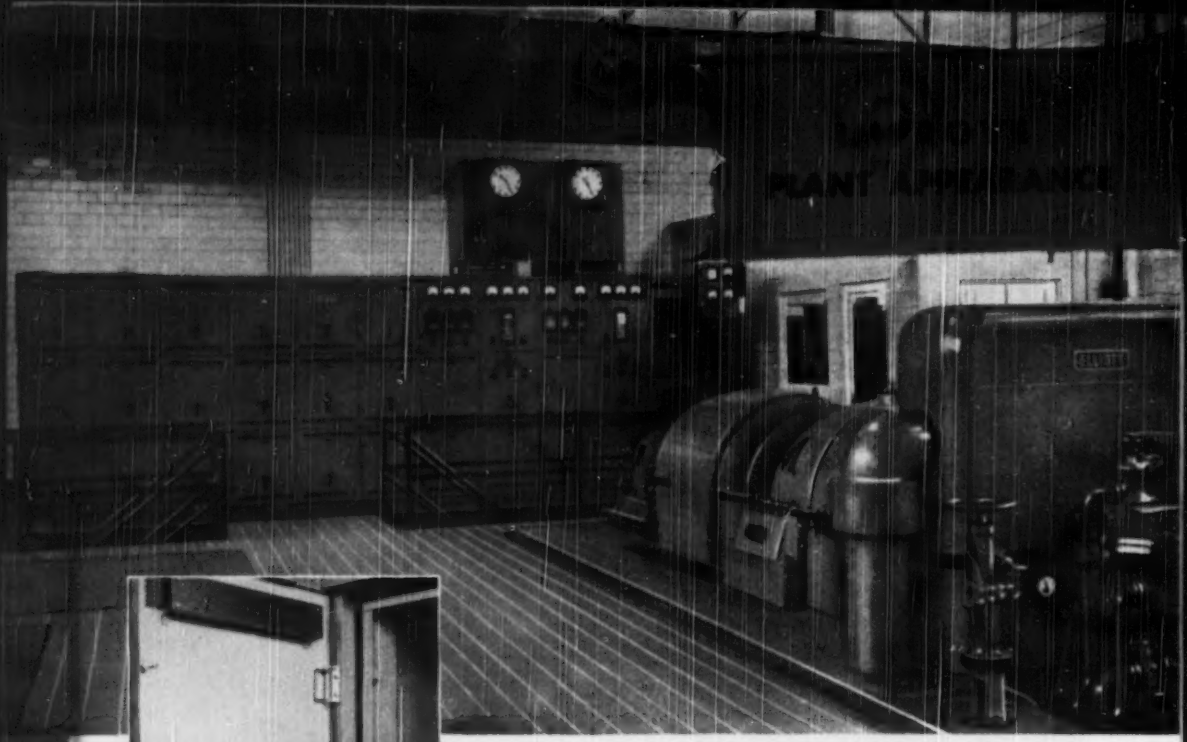
Where transformer dependability is essential to continuity of service, you can rely upon the built-in quality of Uptegraff POWER Transformers. This has been amply demonstrated by the operating records of Uptegraff Transformers in numerous rural systems.

Design and construction details reflect extensive experience and skill in the manufacture of transformers. Uptegraff versatility and manufacturing flexibility permit the prompt delivery of transformers made to meet *your* particular requirements.

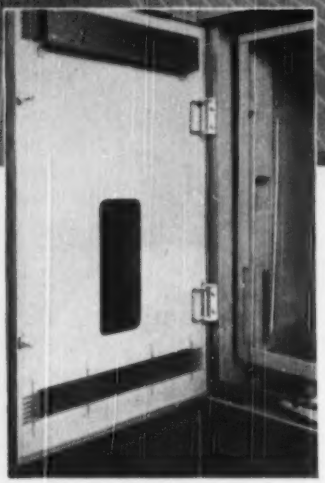
Uptegraff Power Transformers are made in sizes up to 10,000 KVA, 69 KV for indoor or outdoor service.



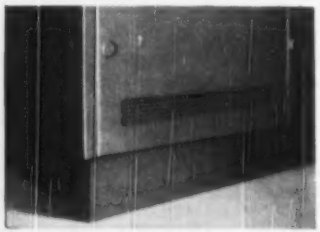
R. E. UPTEGRAFF MANUFACTURING COMPANY
SCOTTDALE, PENNA.



Photograph—Courtesy Falls City Brewing Co., Louisville, K



All panels and doors are full-formed sheet steel. Corners are turned and welded for greater rigidity. All hinges are concealed by being mounted *inside* the enclosure. Effective grilled louvers contribute to the smooth, neat appearance of the switchboard.



Practical and attractive sturdy channel base can be bolted to the floor, or it can be inset either part-way or flush with the floor surface. Formed top trim and end panels complete the elimination of dangerous and unsightly raw metal edges.

MULTUMITE SWITCHGEAR IS ATTRACTIVE!

Note the compactness and beauty in the construction of the typical Multumite assembly above. With the exception of the breaker-operating handles and the semi-flush instruments, the exterior of the board presents a flat surface from top to base. All parts of the enclosure are full-formed from sheet steel—there are no raw metal edges. Grilled louvers and easy-to-adjust door hinges are hidden inside, adding to the pleasing appearance of the board.

The exterior finish of Multumite switchgear is an oven-baked synthetic enamel—bonderized to the metal to guarantee a permanently attractive surface.

GET THESE DESCRIPTIVE BULLETINS:

6003-D A complete reference guide to I-T-E 600 V Switchgear assemblies. Contains dimension information on I-T-E Multumite, and helpful facts for specifying and ordering complete switchgear installations.

7000-A Describes I-T-E's newest 5 KV Switchgear—is illustrated and supplemented with practical, easy-to-read drawings and diagrams. If you have any questions on modern HV switchgear construction, it will pay you to have this bulletin.

Get both bulletins—ask your local I-T-E Representative, or write I-T-E General Offices.

get Extra Protection— SPECIFY I·T·E MULTUMITE SWITCHGEAR!

I-T-E Multumite Switchgear is specially designed to provide the *extra margin of safety* so necessary to uninterrupted service of electrical circuits. Metal-enclosed Multumite Switchgear assures positive protection of secondary distribution systems. *Here are some reasons why:*

1. Breaker's metal panel separates bus and breaker compartment, seals off ionized gases.

2. Silver-plated buses and connections eliminate progressive oxidization, minimize temperature rise.

3. Easy accessibility of breakers and bus compartments facilitates inspection and maintenance.

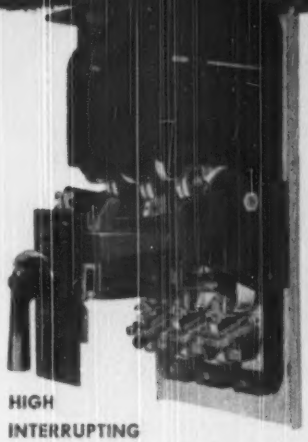
4. Enclosure of control wiring in metal troughs provides a new degree of safety and protection.

5. Specially designed arc chutes quench arcs *quickly* and dependably, *in air.*

6. Breakers are mechanically and electrically trip-free.

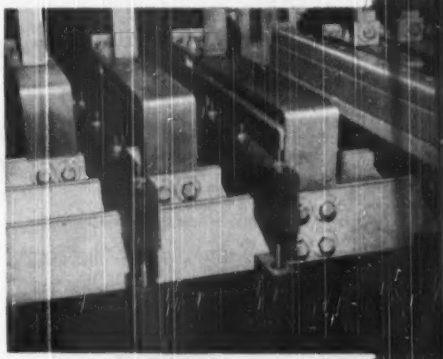
These examples of extra quality—extra protection built into I-T-E Switchgear are typical. Investigate the others.

All I-T-E Switchgear assemblies offer the benefits of an application planned for your specific needs, with units coordinated for most effective protection. Quick, easy installation is assured. *Complete* assembly is tested *before* shipment. Quality is fully guaranteed.



HIGH INTERRUPTING CAPACITY BREAKERS

TYPE KB Breaker. 25,000 RMS Amps. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or electrically operated.



IDEAL BUS ARRANGEMENT

MULTUMITE BUS is arranged for adequate electrical clearance. Strong bracing with sturdy insulating supports assures withstanding maximum short circuit stresses. Bolted connections provide solid contact and rigidity.

I-T-E

R&IE

For *more dependable* Switchgear

specify I-T-E!

I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS RESISTORS • SPECIAL PRODUCTS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

IT TAKES A UNIT-BUILT DAMPING MAGNET

FOR *Calibration that "stays put"**

The permanent magnet of a Watthour Meter must provide a constant restraining force on the rotating element.

A special chrome-steel, treated and aged, gives constant strength to Westinghouse damping magnets . . . throughout the life of the meter. Temperature compensation means calibration "stays put" under all temperature changes. Copper plating guards against the weakening effect of lightning surges.

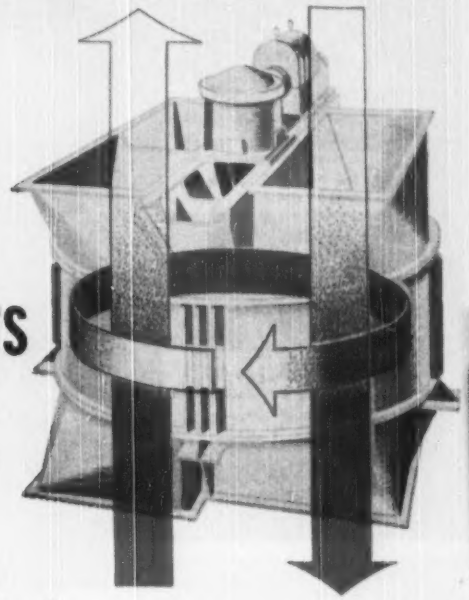
Nothing is overlooked. Mounting surfaces are precisely machined. The magnet can't shift or slip. It may be removed and replaced without disturbing calibration. Maintenance time is reduced to a bare minimum.

These refinements are characteristic of the care and workmanship that go into Westinghouse Watthour Meters. Get the complete story. Write for the new booklet, "What It Takes for Long-time, Low-cost Metering", B-4665, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40368

Westinghouse METERS

*A VITAL PART OF **LONG-TIME, LOW-COST METERING***

How the Ljungstrom Air Preheater can modernize "middle age" boilers



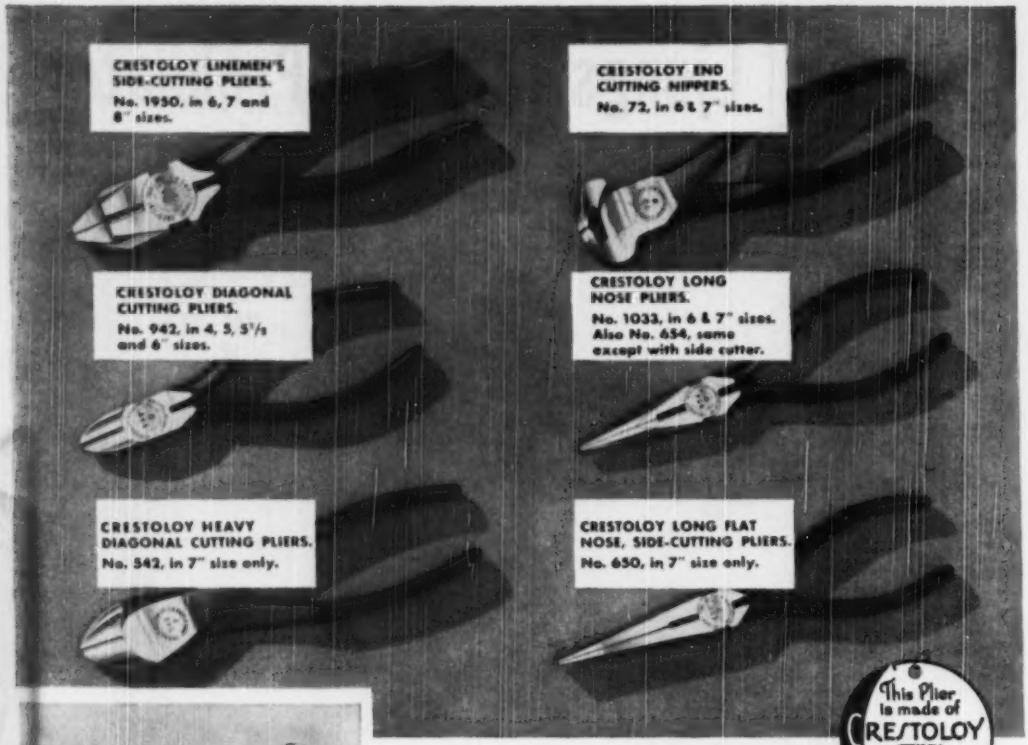
The lightness and compactness of the Ljungstrom Air Preheater makes installation possible on "middle age" boilers with minimum change in the existing structure. This addition of the Ljungstrom Air Preheater, with its continuous regenerative counterflow principle permits operation at lower exit gas temperatures . . . assuring increased heat recovery and reducing the amount of fuel required.

In a matter of a few years the Ljungstrom Air Preheater will effect savings that will more than offset the initial installation cost. If you are interested in approaching modern performance standards with your "middle age" boilers, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the overall efficiency of your plant.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.


CRESTOLOY LINEMEN'S SIDE-CUTTING PLIERS.
No. 1950, in 6, 7 and 8" sizes.
CRESTOLOY END CUTTING NIPPERS.
No. 72, in 6 & 7" sizes.
CRESTOLOY DIAGONAL CUTTING PLIERS.
No. 942, in 4, 5, 5 1/2 and 6" sizes.
CRESTOLOY LONG NOSE PLIERS.
No. 1033, in 6 & 7" sizes. Also No. 654, same except with side cutter.
CRESTOLOY HEAVY DIAGONAL CUTTING PLIERS.
No. 542, in 7" size only.
CRESTOLOY LONG FLAT NOSE, SIDE-CUTTING PLIERS.
No. 650, in 7" size only.

This Plier is made of CRESTOLOY STEEL and has tested 100%

CRESTOLOY PLIERS

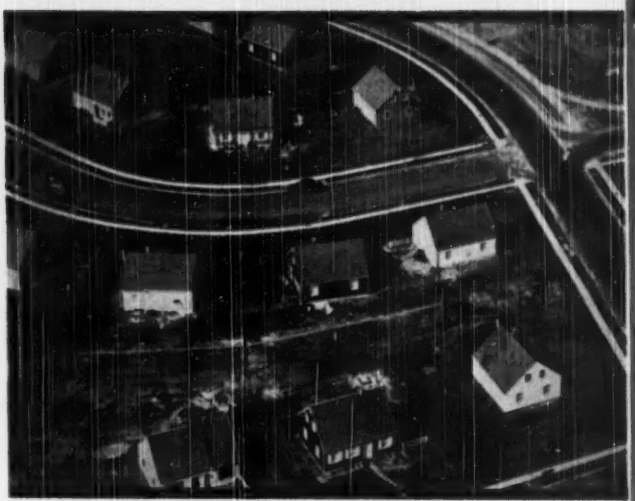
are individually tested!

Crestoloy Pliers take all the guesswork out of plier buying, because Crescent has taken all the guesswork out of plier making. Rigid specifications establish the material, design, workmanship, tests and inspection of these better tools. Strict adherence to these specifications is maintained by continuous tests and relentless inspection of the *individual* tools. Every plier carries the Crestoloy tag certifying that it has been individually tested.

"Crescent" is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

FOR HIGHWAYS...



...OR HOMES

Neoprene-jacketed cable means economical, trouble-free service

Out in the open, neoprene-jacketed cable withstands sunlight, weather, ozone, heat and cold . . . resists chemical deterioration in industrial areas, oil and grease. It can stand scuffing and abrasion from trees; will not festoon. Underground, a tough, durable neoprene jacket offers protection against crushing and denting by settling earth. And it withstands the effects of acid and alkaline soil; or galvanic action, which is destructive to metal sheaths.

So make sure the cable you use is designed for long, trouble-free service—with a jacket of Du Pont neoprene. Although Du Pont does not make neoprene products, leading wire and cable manufacturers use neoprene for their quality constructions. Your distributor can supply you. And if you'd like to read about new neoprene applications that may help *you*, we'll put you on our mailing list for "The Neoprene Notebook." Write: E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Div. G-8, Wilmington 98, Del.

NEOPRENE

The rubber made by Du Pont since 1931

DU PONT

ELECTRICAL INSULATION IS OUR SPECIALTY

Q. *What ONE wire and cable producer grows its own natural rubber, and makes its own synthetic rubber?*

A. UNITED STATES RUBBER COMPANY.

Q. *What ONE wire and cable producer makes plastics?*

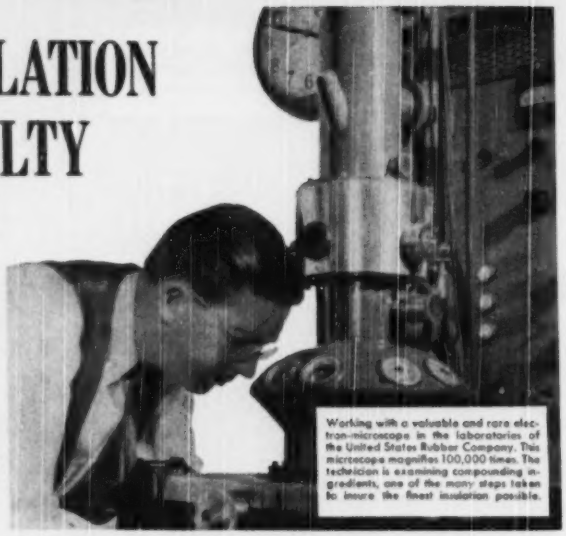
A. "U. S."

Q. *What is the most important part of wire and cable?*

A. The insulation.

Q. *Who is best equipped to make wire and cable with superior insulation?*

A. U. S. RUBBER—which grows its own natural rubber, makes its own synthetic rubber, manufactures its own plastics.



Working with a valuable and rare electron-microscope in the laboratories of the United States Rubber Company. This microscope magnifies 100,000 times. The technician is examining compounding ingredients, one of the many steps taken to insure the finest insulation possible.

Isn't it logical that a rubber company should make the best wire and cable insulation there is? U. S. Rubber has been a pioneer in insulation for over 70 years—has amassed in that time a stockpile of research data and experience that can't be beat. Electrical insulation is a "U. S." specialty!

Electrical insulation makes the difference between superior and ordinary wire and cable. Conductors of all manufacturers are standard, but insulation must be the best that science can produce. That's why your best bet in wire and cable is U. S. Rubber.

SOME MORE OF THE MANY DIFFERENT VARIETIES OF "U. S." WIRE AND CABLE

BUILDING: Laytex RU—world's smallest diameter, lightest weight natural rubber covered building wire. **Neolay RU**—with Laytex insulation plus Neoprene; nylon cover makes pulling 5 times easier. **Laytex RUW**—with the insulation resistance that increases in wet locations.

Neoprene Covered Service Entrance Cable—Flame-retardant, moisture resistant—first ever accepted by Underwriter's Laboratories, Inc. **Aluminum Wires and Cables. Cord Sets with Electrix Plugs.**

HEAVY INDUSTRY: Power Cables—of every description including Neolay Aircraft Wire. **Royal Master Portable Cords. Royal Mining Machine and Locomotive Cables**—tested seven different ways to insure complete dependability. **Control Wires**—insulated with Laytex RU for greater circuit integrity. **Municipal Signal Cables**—Insulated with Laytex RUW for maximum moisture-resistance. **Welding Cables • Machine Tool Wire • Switchboard Wire • Thermostat Cable • Bus Drop Cable.**

HERE'S WHY U. S. RUBBER INSULATION "KNOW HOW" MAKES THE WORLD'S BEST BUILDING WIRE

Six No. 14 Type R wires fit in ordinary conduit
Eleven No. 14 Laytex Type RU wires fit in same size conduit (Rewiring only)
MORE WIRES PER CONDUIT

U. S. Laytex RU Building Wire is smaller in diameter than ordinary wires. Its insulation is applied with uniform thickness, resulting in perfect centering and no thin spots. A unique dip or pass method, perfected by U. S. Rubber Company, applies 90% pure rubber to the conductors, eliminating the usual bulkiness and weight. On rewiring jobs, eleven No. 14 Laytex Type RU wires fit in a conduit that ordinarily would hold only six No. 14 Type R wires. A special wax finish makes this wire 33% to 300% easier to pull than the average, according to laboratory tests.

U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE & CABLE DEPT. • ROCKEFELLER CENTER, NEW YORK 20, N.Y

- **MECHANICALLY TRIP-FREE PNEUMATIC OPERATOR** *assures positive tripping*
- ***UNITOP* FRAME CONSTRUCTION** *eliminates dirt-and-moisture-collecting crevices*
- **SINGLE-BREAK *RUPTOR* INTERRUPTING DEVICE** *for low arc energy release*

HERE'S HOW the Allis-Chalmers pneumatic operator with mechanically trip-free design assures instant tripping under any conditions. *On a fault, the operator is mechanically unlatched from the tripping mechanism.* By isolating tripping and closing mechanisms in this way, the tripping force doesn't have to work against valves or back pressures of any kind. This positive tripping action is a standard feature on all FZO-150 breakers.

COMPLETE WEATHER PROTECTION

One-piece, continuous heavy steel *Unitop* construction eliminates crevices that collect dirt and moisture. All three poles, under one top, are completely protected against severe weather conditions. Wiring is carried in sealed ducts within the top frame.

FAST, EFFICIENT INTERRUPTION

Arcs are quickly extinguished with simple, single-break *Ruptor* interrupting device. No unnecessary moving parts to bind or fail. Self-wiping, self-aligning contacts prevent formation of high resistance oxides, have low temperature rise.

Every FZO-150 breaker is factory assembled and tested, then shipped without dismantling so that test performance will be met in the field.

For details on the FZO-150 (bulletin 71B6421A) or other breakers to meet any utility need, contact your nearby A-C sales office. A-3072

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

STANDARD RATINGS
3 cycle interruption

Rated KV	Max. Design KV	Rated Amps. (60 cycle)	Kva. Interr. Cap.
14.4	15.5	1200	1,000,000
14.4	15.5	2000	1,500,000
23.0	25.8	1200	500,000
34.5	38.0	600	500,000
34.5	38.0	1200	1,000,000
34.5	38.0	1200	1,500,000
34.5	38.0	2000	2,500,000
46.0	48.3	600	500,000
46.0	48.3	1200	1,500,000

Unitop and *Ruptor* are Allis-Chalmers Trademarks.

ALLIS-CHALMERS

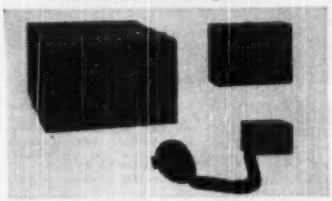
HIGH SPEED PROTECTION
LOW IMPULSE CHARACTERISTICS
FAST MULTI-GAP SPARK GAP OXIDIZED
SILICON CARBIDE VALVE ELEMENT
All are features that make possible the high-speed operation of Crystal Valve Lightning Arresters . . . assure your equipment and service of extra protection against lightning "blackouts."
Speed of operation is controlled largely through spark gap design and construction. Crystal Valves embody time-proved spark gap units of multi-gap construction and sparkover or discharge surfaces that are smooth and flat.
Oxidized Silicon Carbide, today's most highly developed valve element, is an exclusive feature in Crystal Valves. It provides:
• Low IR voltage drop and ample surge voltage reduction, with adequate surge energy absorption.
• Extremely marked valve action for follow current interruption.
• Long life since no measurable deterioration occurs after years of normal service.
Specify proved protection . . . order Crystal Valves. Write today and let us put your name on the list to receive our series of instructive booklets on lightning protection.
ESM
LIGHTNING ARRESTERS

ELECTRIC SERVICE MANUFACTURING CO. • 1709 Cambria St. • Philadelphia 32, Penna.

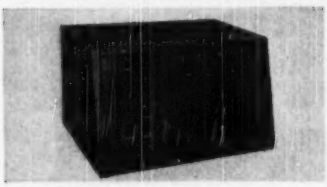
CRYSTAL VALVE
LIGHTNING ARRESTERS

After unbiased comparative tests— the STATE of FLORIDA *goes RCA!*

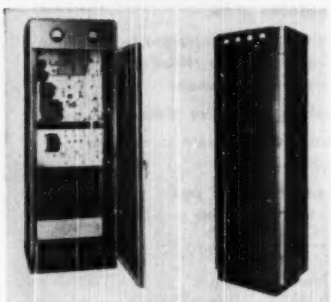
Florida uses the complete RCA Fleetfone System



• Mobile Fleetfone 30 watts



• Station Control



• Station Fleetfone 70 watts

• Station Fleetfone 250 watts

RCA 2-way Fleetfone radio chosen after tests by the University of Florida Laboratories

WHEN THE Florida State Highway Patrol prepared to expand its 2-way radio system to cover the entire state, competitive bids were invited and manufacturers were asked to submit equipment for tests.

The University of Florida Laboratories submitted these equipments to a series of gruelling tests to determine reliable car-to-car communication distance, adjacent-channel interference, and maximum headquarters-to-mobile range.

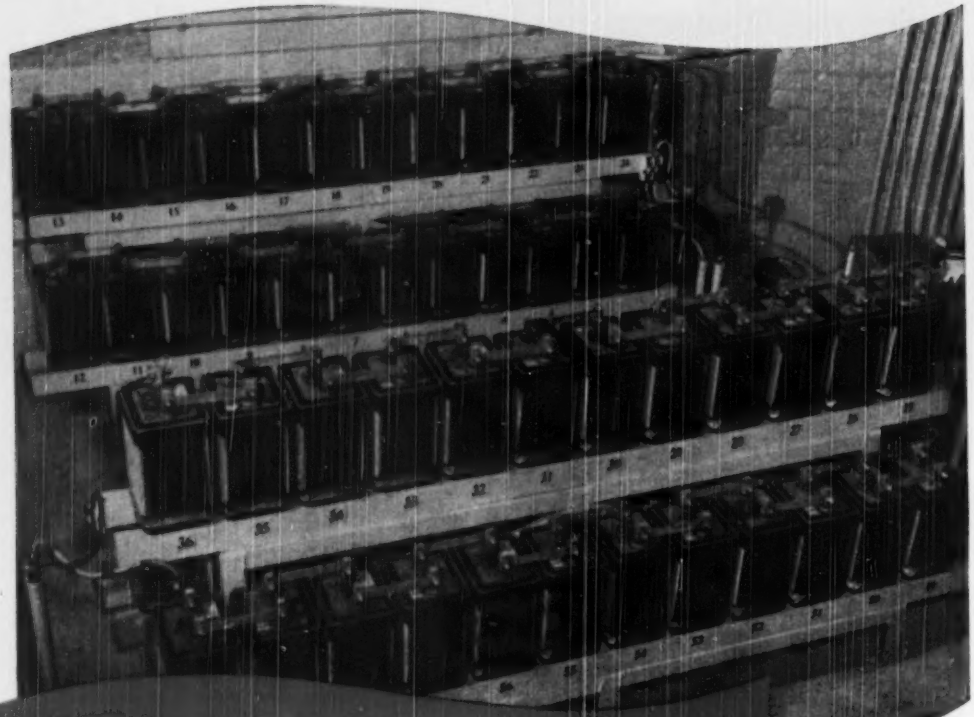
Result: Florida has ordered RCA Fleetfone 100%!

. . .

Plan your communications system around *laboratory-approved* equipment. Go RCA. The RCA Fleetfone (for 30 to 50 mc operation) and its companion, the RCA Carfone (for 152 to 174 mc operation) offer the finest in mobile communications.

For information and help on any type of two-way radio system, call or write Dept. 31-H, RCA Engineering Products, Camden, N. J.

MOBILE COMMUNICATIONS SECTION
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.
In Canada: RCA VICTOR Company Limited, Montreal



After 24 years' service, another Exide, the new...
EXIDE-MANCHEX BATTERY

New installation of 60-cell DME-13 Exide-Manchex Battery which replaced older Exide batteries, which served a substation in southeastern Wisconsin for 24 years.

In 1925, a utility in southeastern Wisconsin installed a 60-cell EMG-7 Exide Battery. Before being replaced in 1949 by the new Exide-Manchex, it had given nearly a quarter-century of continuous service.

The new Exide-Manchex Battery operates a number of 34.5 KV oil circuit breakers and provides emergency lighting in the attended substation. Indicating lamps are on each control circuit.

For positive operation of switchgear, plus an adequate and uninterrupted supply of current for all your stationary battery requirements, use Exide-Manchex Batteries. They assure you dependable performance, long battery life and low-cost maintenance.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

You get all these in EXIDE-MANCHEX BATTERIES

The *exclusive*, long-life manchester positive plate.

Slotted plastic separators, impervious to chemical and electrical reaction.

Plastic spacers for plate alignment.

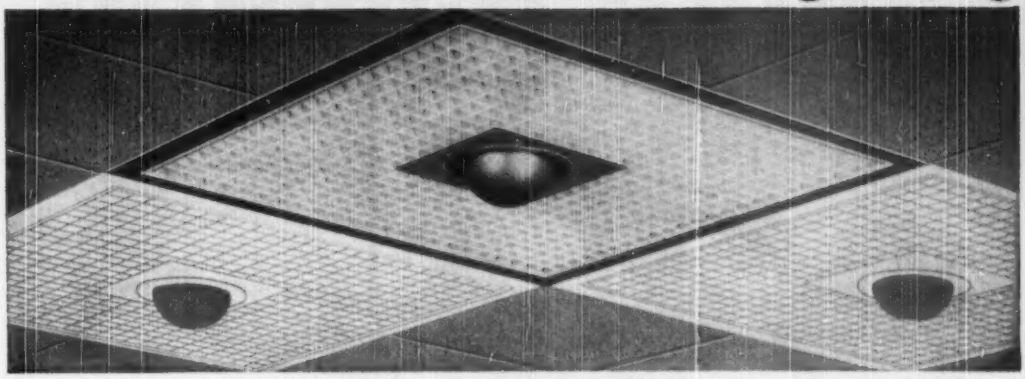
Latest development in molded glass jars.

Heavy terminal posts with copper inserts for extra conductivity.

"Exide" and "Manchex"
Reg. Trade-marks U.S. Pat. Off.

1888 . . . DEPENDABLE BATTERIES FOR 62 YEARS . . . 1950

Now-a new kind of Lighting



...with all the advantages of incandescent *Plus* the modern appearance of fluorescent! SILVRAY Skylike*

The SKYLIKE system brings you a new *concept* of lighting . . . makes it possible for you to offer your commercial customers something dramatically different, better—and lower-cost! In addition to superior-quality illumination for seeing and for selling—and other features of strong appeal to *users*—SKYLIKE has the *contractor* advantages of simple wiring, light weight and fast installation, and complete freedom from service call-backs.

In fact, this new adaptation of silvered-bowl incandescent lighting provides a combination of important practical advantages not found in any other lighting system:

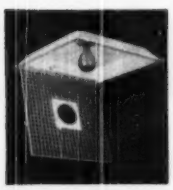
1. **High initial and maintained light output.**
2. **Softly diffused shadows.**
3. **Low brightness and 90° shielding.**
4. **No flickering, blinking, or hum.**
5. **Warm color—most desired by merchandising experts.**
6. **Instant starting.**
7. **Variable lamp size—150- to 500-watt.**
8. **No light loss from darkened walls or ceilings.**
9. **Floor-service relamping—no ladders or scaffolds.**
10. **Hermetically sealed silver reflecting surface.**

WIDE FREEDOM OF USE

In addition to all its technical advantages, SKYLIKE is modern, handsome, and versatile in application. Units fit 24" x 24" ceiling tiles, fully or partially recessed, or may be surface-mounted—in rows or patterns. With a simple accessory and a semi-silvered-bowl lamp, SKYLIKE is converted for directional or accent lighting.

AMAZINGLY LOW-COST!

Because it is so simple—simple in construction; simple in wiring; free of ballasts, starters, and accessories—SKYLIKE is low in cost (½ to ⅓ the cost of equipment delivering comparable results!). Its light weight makes for easy handling, fast installation, and lower-cost supporting construction. There's no transformer or starter maintenance. SKYLIKE can be relamped from the floor (no step-ladder!) with a lamp changer.



EASY TO CLEAN—The 87% reflection factor of SKYLIKE's enamelled ceiling is easily maintained by occasional cleaning with a damp cloth. Relamping can be done from the floor.

ACCENT LIGHTING or directional lighting is readily accomplished with SKYLIKE by the substitution of a semi-silvered-bowl lamp and a simple accessory, as shown above.

*Patent pending

Send coupon for complete data

Graybar Electric Co., Inc.
Graybar Building,
420 Lexington Ave.
New York 17, New York

SILVRAY Skylike*

Please rush me details of Silvray SKYLIKE lighting.

Name..... Title.....

Firm.....

Address.....

City..... Zone..... State.....

3045 EW

adding feeders?

Unless you figure them in Aluminum, you don't

figure low

Figure your next run of insulated feeder cable both ways—in copper and in aluminum. See how much you can save with *aluminum*. The savings will surprise you.

For names of manufacturers and copy of "Questions and Answers about Insulated Aluminum Conductors", phone your nearby Alcoa sales office or write ALUMINUM COMPANY OF AMERICA, 1786H Gulf Building, Pittsburgh 19, Pennsylvania.

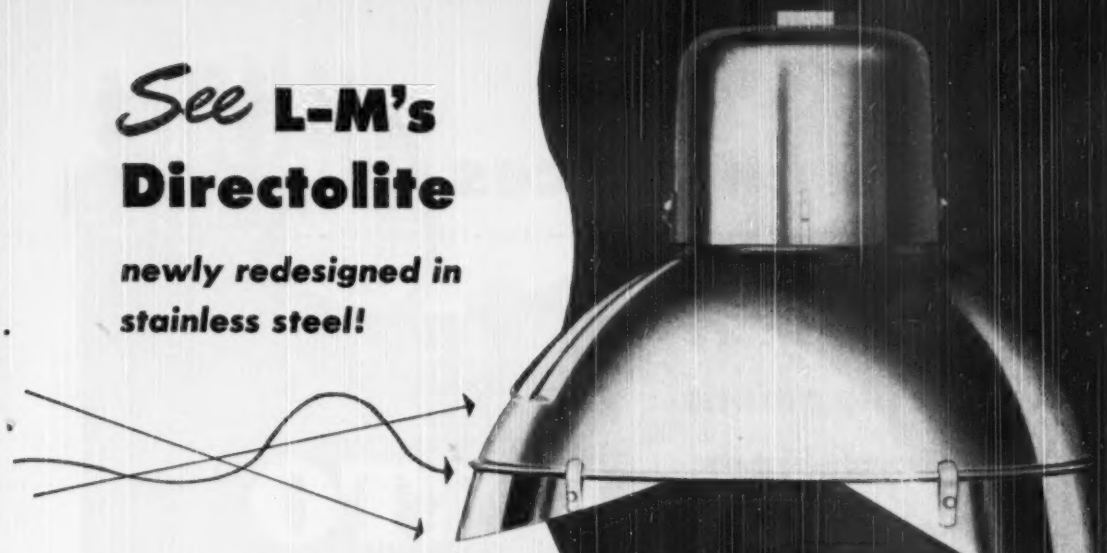
Insulated **Aluminum Conductors**

ALCOA

of ALCOA EC ALUMINUM are made by leading manufacturers

See L-M's Directolite

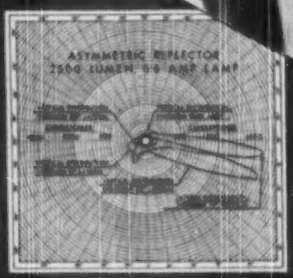
newly redesigned in stainless steel!



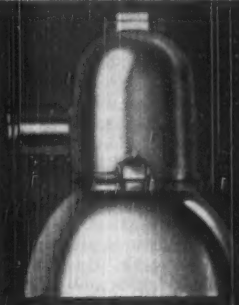
L-M's famous *Directolite* reflector has now been redesigned, in tarnishproof stainless steel, to give even greater overall efficiency for a longer time. *Directolites* are made in the asymmetric design shown above at right, which provides I.E.S. type II light distribution, and in two sizes of the symmetric style for type V pattern, in the lower illustration.

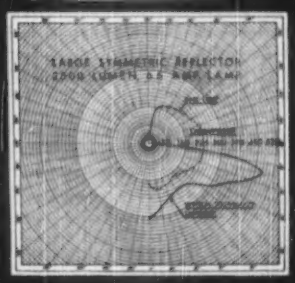
The *Directolite* provides efficient, low cost illumination for smaller communities, residential areas, and outlying sections. It uses 1000 to 2500 lumen series or multiple lamps. It is easily interchangeable with larger luminaires on the same head when population or traffic growth requires it.

Take a look at the new stainless steel *Directolite!* It costs about the same as a radial bowl; but it provides a difference in illumination that citizens can see and appreciate. L-M offers a complete line of street lighting equipment including the new design bracket shown above; and complete street lighting engineering service.



Candlepower distribution curves of the asymmetric type Directolite, which provides lateral control to give I.E.S. type II distribution.





Candlepower distribution curve in vertical plane, I. E. S. type V, symmetric type Directolite.

Get this Bulletin

For more information ask your utility company or the L-M Field Engineer about L-M Directolites and a copy of this bulletin; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

(LM-7529)

LINE MATERIAL Street Lighting

Complete Coordinated Equipment for

L-M Announces

a revolutionary new development in transformer oil

"ORTO"* brand oil is a revolutionary new inhibited oil that resists oxidation, acidification, and sludging. It lasts several times as long as a high-grade conventional oil. Therefore it offers these advantages:

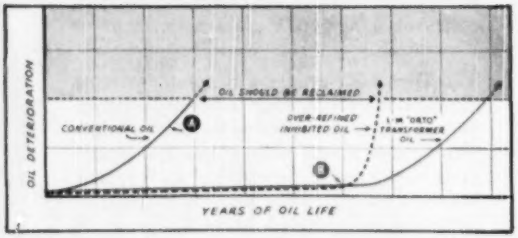
1. **Improved overload capacity**
2. **Longer transformer life**
3. **Lower maintenance costs**

"ORTO" brand oil has been thoroughly tested. Its advantages are conservatively stated. It does not deteriorate suddenly after the inhibitor has been used up. In "ORTO" the inhibitor lasts many years. After that the oil still has inherently long life, with normal resistance and characteristics; and it then simply begins the normal rate of deterioration.

All this time "ORTO" has kept cooling oil passages clear of sludge, permitting the original unrestricted oil circulation, and maintaining the original high short-time overload capacity. By preventing the formation of acids, "ORTO" has protected cellulose insulation from deterioration, and has prevented the corrosion and rust caused by acidified oil.

"ORTO" brand oil is now available exclusively in L-M Round-Wound and other L-M distribution transformers.

Ask the L-M Field Engineer for complete information, or wire or write Transformer Sales Department, Line Material Company, Zanesville, Ohio (a McGraw Electric Company Division).



Comparative curves show the deterioration of transformer oil in service. A high-grade conventional oil deteriorates at a gradually accelerating rate. Over-refined oils may have a better response to the inhibitor; but once the inhibitor has been used up, the oil has little resistance to oxidation, and deteriorates rapidly. "ORTO" brand oil is a high-grade conventional oil with an inhibitor which greatly extends the beginning of the deterioration, which, when it finally starts, assumes the same gradual curve as with any high-grade conventional oil.

*Trademark

10-1

LINE MATERIAL... Transformers

Complete Coordinated Equipment for Distribution Today

ROUND COILS L-M WOUND CORE

REG. U.S. PAT. OFF.

protected with

ORTO

GET THE ADVANTAGES OF

L-M ROUND-WOUND TRANSFORMERS

. . . NOW EVEN GREATER

WITH "ORTO"* OIL

Among the many advantages of L-M's exclusive Round-Wound design are high short-time overload capacity, high impulse strength, and long life for the transformer, with low maintenance and low operating costs.

These advantages have been outstanding, even in L-M Round-Wound transformers using high-grade conventional oils.

Today, L-M Round-Wounds (and other L-M distribution transformers) are supplied filled with "ORTO" brand oil. Because it is a high-grade inhibited oil, "ORTO" greatly enhances the advantages inherent in the Round-Wound design. Because "ORTO" maintains its original condition for many years, the transformer itself maintains its initial high overload capacity for a much longer time.

Because the oil is kept free from acids, insulation is not subject to deterioration by oil acids; and the transformer maintains its high impulse strength for a far longer period.

Because all parts of the transformer share in the long life, maintenance costs are lower, and operating costs remain at a low level for a much longer period. Thus with "ORTO" brand oil, L-M Round-Wound transformers offer an even greater return on the investment to their users.

Look for the Green Shield!

L-M distribution transformers with "ORTO" brand oil are available in conventional, Completely Self-Protected, and subway types, single-phase and three-phase units. For information ask the L-M Field Engineer, or write Line Material Company, Transformer Sales Department, Zanesville, Ohio (a McGraw Electric Company Division).

*Trademark

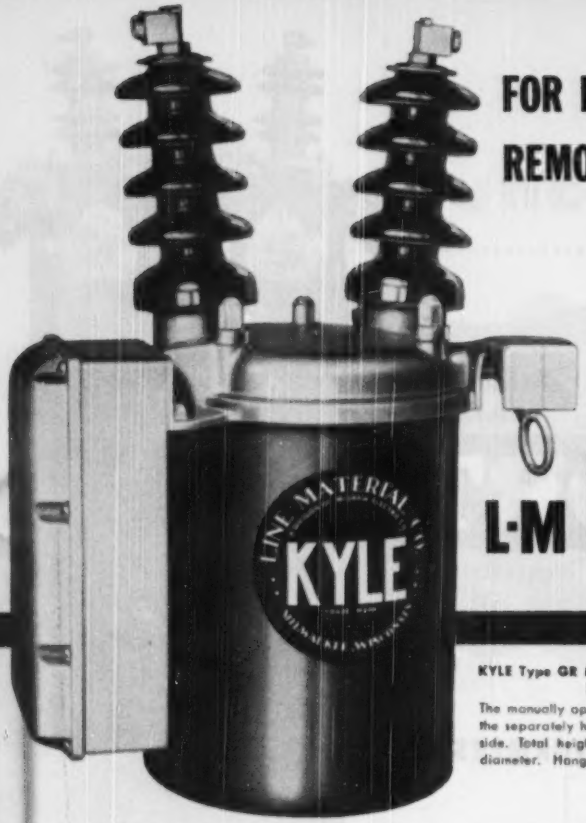
10-4

LINE MATERIAL . . . Transformers

FOR DEPENDABLE MANUAL OR REMOTE CONTROL OF

capacitors . . .
street lighting . . .
airport lighting . . .
flood and other outdoor lighting . . .
sectionalizing . . .

L-M KYLE OIL SWITCHES



KYLE Type GR Motor-driven Remote-Control Oil Switch
100 amperes, 15,000 volts

The manually operated type G looks the same except for the separately housed motor-control mechanism on the left side. Total height including bushings, 18½", tank, 7⅛" diameter. Hangers for direct pole or crossarm mounting.

● L-M's KYLE oil switches are available in manual control type G, in electric remote control type GR, and in the new three-pole manually operated type 3G shown at right.

They are sturdy, dependable, economical; they provide many features that make them most desirable for a variety of light-duty load-break operations within their 15 kv 100 ampere rating.

KYLE switches provide fast operation. Contacts are fully open in less than a cycle. Double copper-tungsten contact tips minimize burning and pitting, assuring long life. The switches are light in weight, easy to install. Cost is moderate (type G costs only $33!); and they give long, dependable service. They are safe to use. The mechanism is insulated from the tank; head and operating handle are electrically dead. The only live parts are the top bushing terminals.

Type GR with Electric Control—The remote-control type GR has a shaded-pole 115-volt 60-cycle AC motor with control and selector switch to open or close the switch. It may also be operated manually if desired. There are no magnets requiring continuous current—the switch uses power only during actual opening and closing. Three single-phase type GR switches may be connected for simultaneous remote switching of three-phase circuits.

There's nothing to stop you from getting full information . . .

Ask the L-M Field Engineer for details and a copy of this inclusive Bulletin CR2 on oil switches, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

Here's a brand-new development—the type 3G gang-operated manual control three-pole switch. Three type G's are mounted in a galvanized channel frame, and joined together with an interconnecting operating link. Shipped as a completely assembled and coordinated three-pole unit.

Operating handle, mounted directly on the pole, is connected to a length of pipe, as desired, which in turn is connected to a bell crank which operates the three switches simultaneously. Same quick-break snap action and long life as the regular G and GR. Solderless grounding lug on switch channel permits grounding entire assembly.

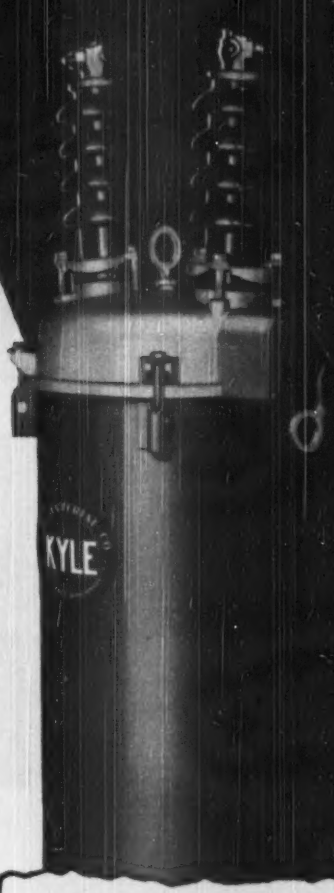
LINE MATERIAL Kyle Oil Switches

KYLE

TYPE "L" OIL CIRCUIT RECLOSER NOW GIVES YOU UP TO

6000 amps interrupting capacity

IN NEW 140-AMP RATING



First recloser actually engineered for heavy-duty service ... full power-class design ... 110 kv insulation impulse level ... ratings up to 140 amps ... only real heavy-duty recloser in its class

Kyle type "L" reclosers cost a little more than lighter-duty reclosers, but they're worth the difference in service, performance, convenience, and freedom from maintenance. Even if you don't need the extra interrupting capacity now, you will need it to take care of future loads; and in the meantime you enjoy all the benefits of type "L" performance and economy.

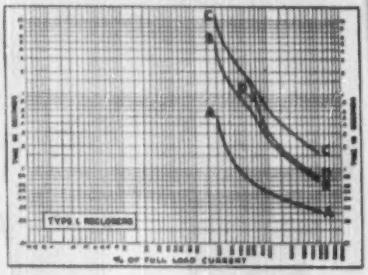
It's the Kyle oil cross-blast method of arc extinguishing, plus heavy-duty design, that makes it possible for the "L" to handle heavy fault currents up to 6000 amps.

The type "L" is the only recloser with so wide a choice of operating sequences. Four standard curves permit any sequence of operation to meet your coordination problems.

Sequence and coil changes are made right in the field—in a few minutes. To change to a coil of different rating, you just remove two screws. To change operating sequence, simply rotate a disc or change one small part. It's quick—and easy! Saves shop trips!

Extremely accurate; virtually no effect from ambient temperature changes. Positive fast operation; positive toggle closing—doesn't depend on gravity. Many safety features: cover and tank electrically dead—bushing tops only live parts; trip-free operating handle. Large sleet hood protects counter and operating handle; may be rotated in 90° steps. Rugged; shock-proof; trouble-free.

ONLY RECLOSER WITH 4 OPERATING CURVES



RATINGS

Coil Rating Amperes	Min. Trip Current Amperes	Maximum Interrupting Capacity Amperes At Maximum Phase-to-Phase Nominal Voltage of		
		4.8 kv	7.2 kv	14.4 kv
25	50	1500	1500	1500
35	70	2100	2100	2100
50	100	3000	3000	3000
70	140	4200	4000	3000
100	200	5000	4000	3000
140	280	6000	4000	3000

Read all about it!

Ask the L-M Field Engineer for a copy of Bulletin CR1A—on the type "L"; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

18

LM LINE MATERIAL...Kyle Reclosers

Complete Coordinated Equipment for Distribution Today

You Don't HAVE to be A SCIENTIST!

Anyone can operate the G-R STROBOTAC with a few brief instructions. Actually they are so simple, here they are:

1 Plug the line cord into any 115-volt 60-cycle a-c outlet.

2 Set the speed selector switch at either LOW or HIGH.

3 Turn the speed control knob very slowly, pointing the flashing beam of the STROBOTAC at the object being viewed. Suddenly the machine or part will appear to slow down. A further very slight turn of the knob and the object will appear to be stationary.

4 On the illuminated drum scale, read the actual speed of the object over any range from 600 to 14,400 rpm. Through simple multiple-flash rules, the speed can be measured up to 100,000 rpm!

That's all there is to it!

Now, if you want to see the machine, equipment or part in s-l-o-w motion, turn the knob very slightly in either direction and the object will appear to move very slowly ... as slowly as a fraction of an rpm, if desired. The operation of gears, belts, moving contacts, cutting edges, grinders and thousands of other devices can be studied while running at normal speeds.

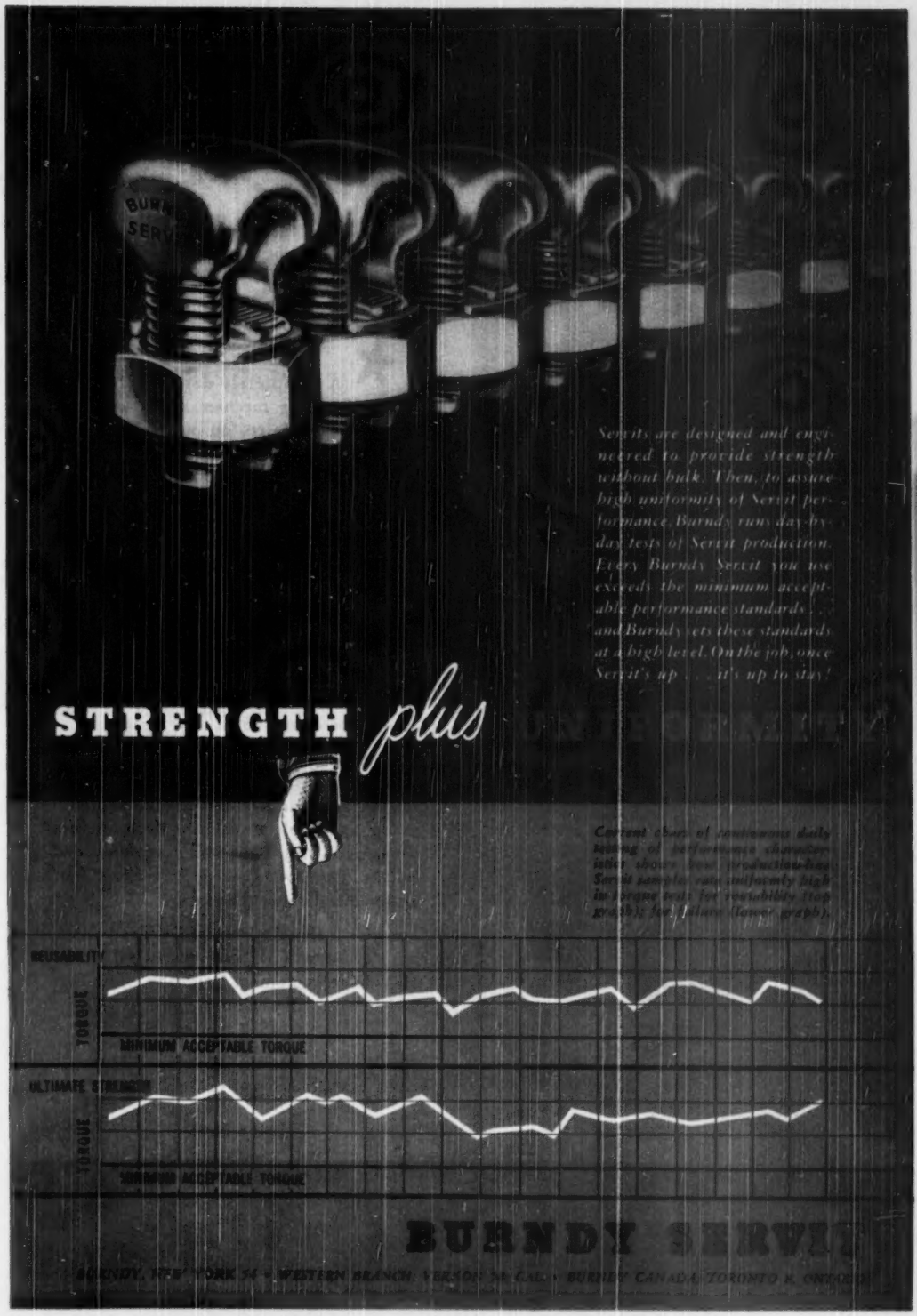
Being essentially a mail-order house, without benefit of door-to-door demonstrator-salesmen, we sell the STROBOTAC through the printed word. Thousands of STROBOTACS are in use in industry by designers, research men, production people, maintenance operators and salesmen! We have hundreds of enthusiastic endorsements from leading industrial organizations all over the world!

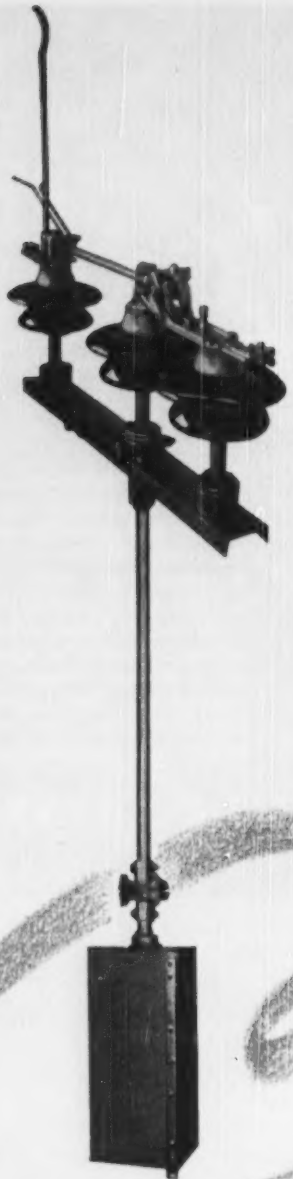
The STROBOTAC, complete and ready for immediate use, sells for only $125.00. It and many other G-R stroboscopic aids for industry are described in detail in a 22-page booklet we have prepared. We'd be glad to send you a copy.

Write for "EYES FOR INDUSTRY"

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38


STRENGTH plus
Servits are designed and engineered to provide strength without bulk. Then, to assure high uniformity of Servit performance, Burndy runs day-by-day tests of Servit production. Every Burndy Servit you use exceeds the minimum acceptable performance standards . . . and Burndy sets these standards at a high level. On the job, once Servit's up . . . it's up to stay!
Current chart of continuous daily testing of performance characteristics shows how production-run Servit samples vary uniformly high in torque tests for reusability (top graph) and final release (lower graph).
REUSABILITY
TORQUE
MINIMUM ACCEPTABLE TORQUE
ULTIMATE STRENGTH
TORQUE
MINIMUM ACCEPTABLE TORQUE
BURNDY



New—

★ A completely dependable, automatic operating mechanism for air-break switches, it requires no outside source of power. It draws current from a battery to actuate the solenoids and relays. It uses the instantly available pressure of compressed nitrogen to open and close your switches.

This new mechanism is adaptable to a variety of chores. Use it to sectionalize transmission lines . . . disconnect branch lines . . . transfer loads from one power source to another. Or you can make any variation on these three basic schemes by using standard relays. The current for the relay coils is .6 amperes at 6 volts.

Maintenance of this new mechanism is easy. Routine inspection will tell you when to change gas cylinders. But you can figure on 25 to 30 complete operating cycles before that's necessary. The battery recommended will hold 85% of its charge for a whole year, and will last about ten years.

Let your Joslyn Representative give you the whole story. Call him today or write: Hi-Voltage Equipment Company, 4000 East 116th Street, Cleveland 5, Ohio.

HI-VOLTAGE

Gas-Operated Mechanism

HOW IT WORKS

1-The mechanism is energized for operation by a relay or a pushbutton.

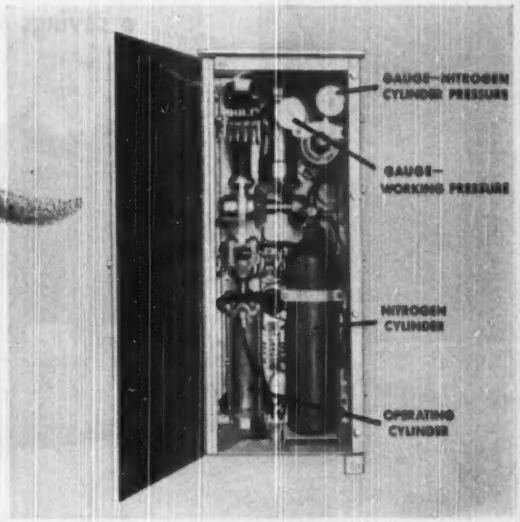
2-Main magnetic valve opens.

3-Either opening or closing valve opens simultaneously with main valve.

4-Gas is admitted to either one end or the other of the operating cylinder. Adjustable needle valves regulate the speed.

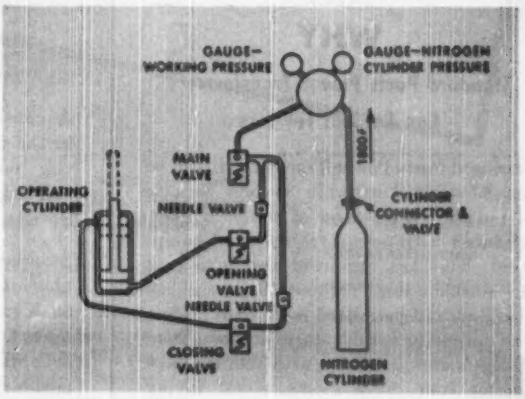
5-Limit switches deenergize valves at end of operation and set circuits for next operation.

Note: For emergency operation, the mechanism may be fitted with a handle for manual control.



SPECIFICATIONS

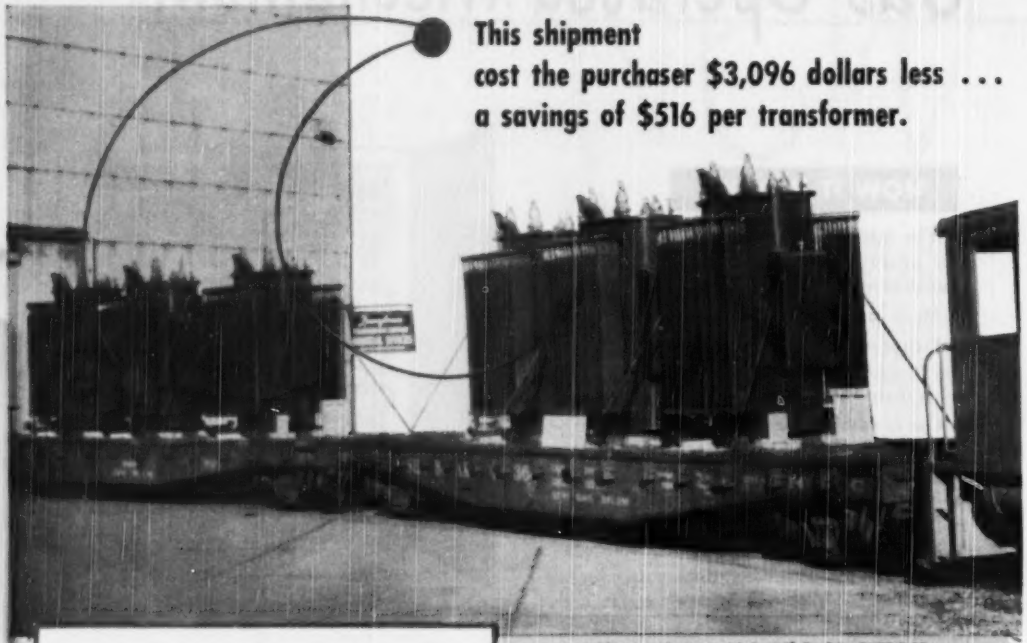
- Size: 32" high, 13" wide, 11" deep.
- Three sizes of operating cylinders available to provide 250, 400 or 500 ft-lbs of operating effort.
- Operating time—3 seconds.
- Stainless steel spring holds switch in open or closed position.
- Completely enclosed in a heavy-gauge metal case.



EQUIPMENT COMPANY

4000 EAST 116TH STREET · CLEVELAND 5, OHIO

You pay LESS for Standard Parts Power Transformers



This shipment cost the purchaser $3,096 dollars less . . . a savings of $516 per transformer.

6-2,000 Kva, 1 phase, 60 C., 55° C., OA, OUTDOOR, — H. V. : 13,800 Volts.
Full capacity taps for 14,400, 14,100, 13,500, and 13,200 volts. — L. V. : 2400 4160Y Volts.
Inert gas — oil seal.

WHY

Standard Parts Power Transformers Can Be Sold For Less

Standard Parts Power Transformers can be purchased at worthwhile savings because of quantity production of standard parts produced with adequate tools and equipment. This has improved the quality of the workmanship, reduced the possibility of errors, and permitted more rigid inspection during the various stages of production. These factors, together with reduced production time, have shown a cost saving which has been passed on to the user.

A considerable amount of money was saved in the purchase of these transformers because the purchaser's requirements — mechanical and electrical — fitted into Pennsylvania's Standard Parts Power Transformer program.

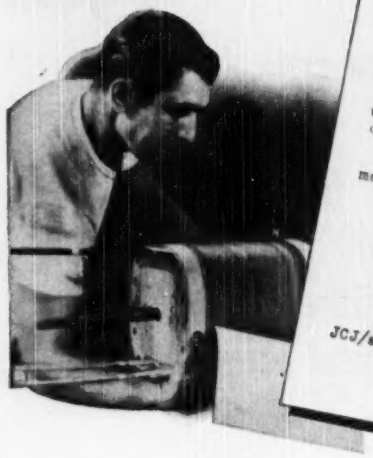
Standard Parts Power Transformers are single phase transformers in sizes up to 5,000 Kva, 69 Kv; and three phase transformers in sizes up to 10,000 Kva, 69 Kv, which have standard or optional voltage ratings and standard or optional accessories. The type of oil preservation method familiar to the purchaser's operating personnel is supplied on these transformers — gas-oil seal, sealed tank, inert gas pressure, or expansion tank system.

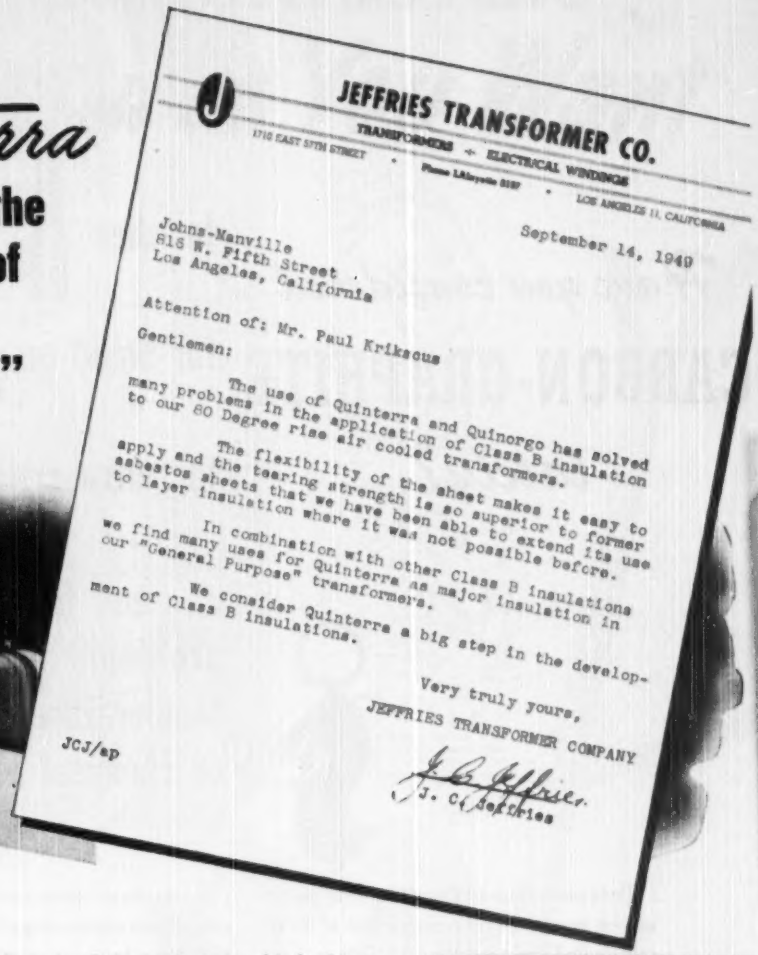
Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

Canonsburg, Pennsylvania — Greater Pittsburgh District

"We consider *Quinterra* a big step in the development of Class B insulations . . ."





JEFFRIES TRANSFORMER CO.

TRANSFORMERS — ELECTRICAL WINDINGS

1716 EAST 57TH STREET · Phone LAfayette 5197 · LOS ANGELES 11, CALIFORNIA

September 14, 1949

Johns-Manville
815 W. Fifth Street
Los Angeles, California

Attention of: Mr. Paul Krikacus

Gentlemen:

The use of Quinterra and Quinorgo has solved many problems in the application of Class B insulation to our 80 Degree rise air cooled transformers.

The flexibility of the sheet makes it easy to apply and the tearing strength is so superior to former asbestos sheets that we have been able to extend its use to layer insulation where it was not possible before.

In combination with other Class B insulations we find many uses for Quinterra as major insulation in our "General Purpose" transformers.

We consider Quinterra a big step in the development of Class B insulations.

Very truly yours,
JEFFRIES TRANSFORMER COMPANY

J. C. Jeffries

JCJ/ap

ONE AFTER ANOTHER, transformer companies like Jeffries are "discovering" Quinterra—the revolutionary, new Johns-Manville purified asbestos, high-temperature, electrical insulation.

. . . And, like Jeffries, they're discovering that Quinterra in a transformer gives them important selling advantages . . . as well as providing many savings in transformer design and production.

Quinterra is a paper-thin flexible, continuous sheet insulation. It is being widely used for interlayer and wrapper insulation in transformers and coils.

Its lasting dielectric strength, due to its resistance to pyrolysis, assures a greater safety factor and longer operating life. Quinterra withstands substantially higher temperatures than the hot-spot limit of 130C for Class B insulations.

QUINTERRA

- ✓ **cuts factory rejects**
- ✓ **reduces complaints**
- ✓ **improves production rate**
- ✓ **produces more uniform product**
- ✓ **cuts costs of operations**

Johns-Manville
ELECTRICAL INSULATIONS

Johns-Manville
Box 290, New York 16, N. Y.

Kindly send me a copy of
Johns-Manville Quinterra Electrical Insulation EL-34A.

Name_____

Company_____ Position_____

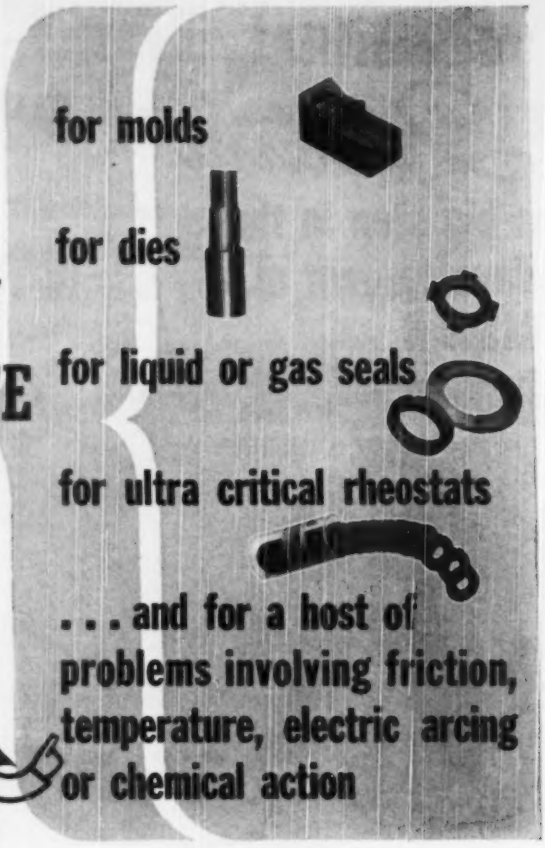
Address_____

City_____ State_____

Have you considered

CARBON-GRAPHITE

lately?

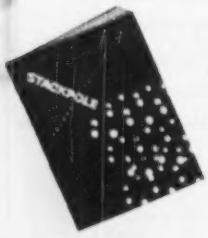

for molds
for dies
for liquid or gas seals
for ultra critical rheostats
. . . and for a host of problems involving friction, temperature, electric arcing or chemical action

Because carbon and graphite have many of the most desirable properties of both metals and non-metallic materials . . .

. . . And further, because a wide (but carefully controlled) variation of measurable characteristics can be obtained without significant change in their chemical composition . . .

. . . Stackpole carbon and graphite products provide outstanding efficiency and economy for a long list of chemical, electrical and mechanical developments.

Stackpole engineers welcome the opportunity to cooperate in solving the most modern design and engineering problems by skilled handling of these basic, highly versatile materials. Send details of your application for recommendation.



Write for
CARBON SPECIALTY
ENGINEERING
DATA BOOKLET 40

STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE

EVERYTHING IN CARBON BUT DIAMONDS

Pacific Electric SWITCHES Have

The Features You Want

- Reduce Friction
- Run Cooler
- Assure Easier Operation
- No Contact Shunts
- Solid-Silver to Solid-Silver Inserts
- High-Pressure Contacts —80 lbs.
- All Nonferrous Above Insulators
- New Terminal Reduces Electric Joints
- Protected Flexible Jumpers

OPENING

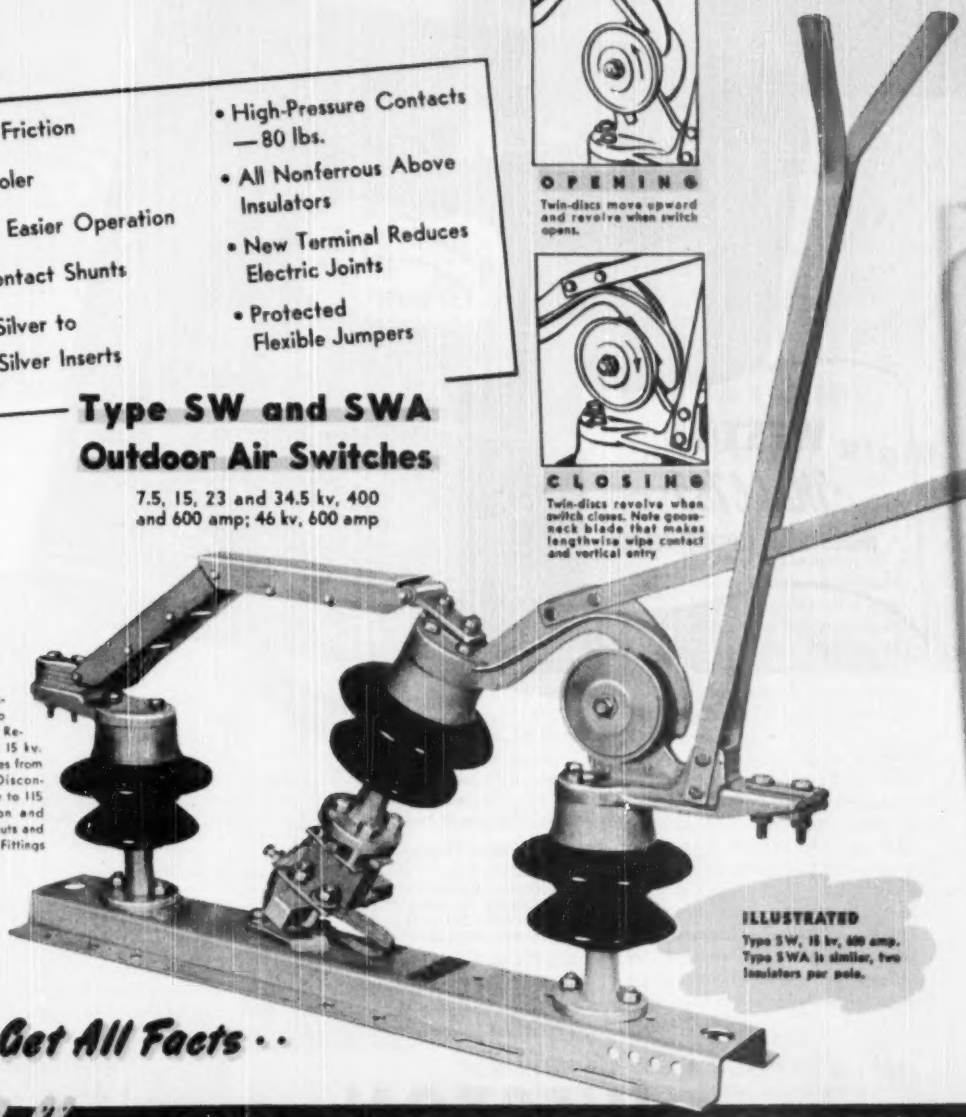
Twin-discs move upward and revolve when switch opens.

CLOSING

Twin-discs revolve when switch closes. Note goose-neck blade that makes lengthwise wipe contact and vertical entry

Type SW and SWA Outdoor Air Switches

7.5, 15, 23 and 34.5 kv, 400 and 600 amp; 46 kv, 600 amp



ILLUSTRATED

Type SW, 15 kv, 400 amp. Type SWA is similar, two insulators per pole.

Other Pacific Electric Products

Oil Circuit Breakers from 7.2 kv to 230 kv. Service Restorers 7.2 and 15 kv. Air Break Switches from 7.5 to 230 kv. Disconnects from 7.5 kv to 115 kv. Distribution and Power Fuse Cutouts and Supports. Bus Fittings and Terminals.

Get All Facts . .

Call

PACIFIC ELECTRIC MFG. CORPORATION

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • P. O. BOX 419, GARY, INDIANA

NO OTHER TESTER

does so much...so well!

WESTON
Model 785
INDUSTRIAL CIRCUIT TESTER

In the shop . . . 28 ranges *in one case* to locate circuit troubles on production equipment.
On the bench . . . 28 ranges *in one case* for checking electrical equipment during manufacture.
In the lab . . . 28 ranges *in one case* immediately available for research and development work.

28 Instrument Ranges

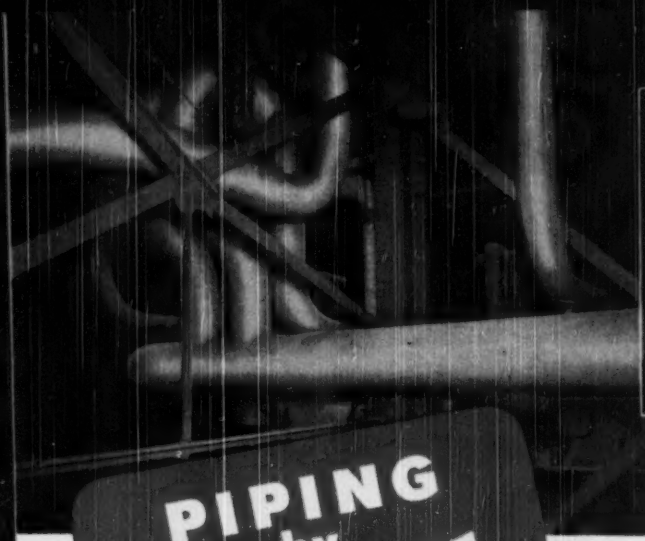
D-C VOLTS: 100 mv, 1/10/50/200/500/1000 volts (20,000 ohms per volt).
A-C VOLTS: 5/15/30/150/300/750 volts.
D-C CURRENT: 50 microamps; 1/10/100 milliamps; 1/10 amps.
A-C CURRENT: .5/1/5/10 amps.
RESISTANCE: 3000/30,000/300,000 ohms; 3/30 megohms.

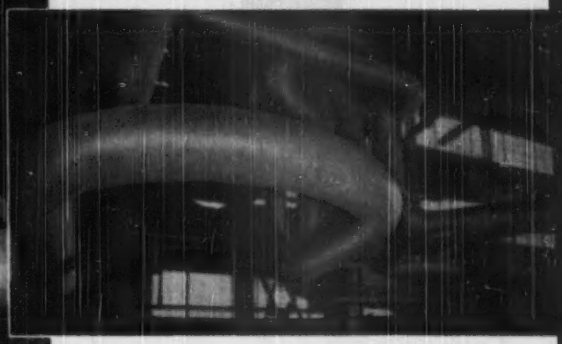
Stock Accessories Available for Extending Above Ranges

It does *so* much, *so* well, for *so* little. Check your Weston Representative for full details or see your local jobber. Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and Tagliabue Instruments.

WESTON *Instruments*

Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville • Little Rock • Los Angeles • Meriden • Minneapolis • Newark • New Orleans
New York • Orlando • Philadelphia • Phoenix • Pittsburgh • Rochester • San Francisco • Seattle • St. Louis • Syracuse • Tulsa • Washington, D. C. • In Canada, Northern Electric Company, Ltd., Power Devices, Ltd.





PIPING by MIDWEST

ANOTHER "First"

NEW SCHILLER STATION

First Complete Mercury-Unit Power Plant

The first installation of a mercury-unit power plant designed and built as a complete power generating unit . . . the Schiller Station of the Public Service Co. of New Hampshire at Portsmouth, N. H. is a notable achievement. When operating at designed rating of 40,000 kw and using Bunker C fuel oil, the heat rate is 9200 Btu per net kwhr.

The piping is by Midwest . . . fabricated and erected with undivided responsibility. "Firsts" are frequent with Midwest . . . have been throughout our more than four decades of experience with piping of all kinds. Midwest has grown up with modern high pressure and high temperature piping . . . through the years has achieved a wide reputation for better piping.

Whether you want a simple pipe bend, a series of complex prefabricated subassemblies, or a difficult piping job completely erected, Midwest has the facilities, the experience and the organization to meet every requirement. You will find it to your advantage to call upon Midwest whenever you need piping.

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St. • Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg. • South Boston 27—426 First St.

4163

MIDWEST PIPING SERVICE IS NATION-WIDE

4 Plants are Better Than 1

PIPING FABRICATORS AND CONTRACTORS

CHEVROLET

ADVANCE-DESIGN TRUCKS

POPULARITY LEADERS Chevrolet trucks are the favorites by far! In every postwar year truck users have bought more Chevrolets than any other make. And that's proof of the owner satisfaction they have earned!

PERFORMANCE LEADERS Chevrolet trucks give you high pulling power over a wide range of usable road speeds . . . cut down total trip time with high acceleration on the straightaway.

PAYLOAD LEADERS Careful design and rugged construction permit you to haul more goods more miles—at lower cost per ton mile! You enjoy real savings on operating and repair costs.

PRICE LEADERS You're money ahead with Chevrolet trucks! Chevrolet's rock-bottom initial cost—outstandingly low cost of operation and upkeep—high-trade-in value, all add up to the lowest price for you.

Packed with VALUE... *Primed with* POWER

Chevrolet Advance-Design trucks have everything it takes —and plenty to spare. Rugged construction to withstand the wear and tear. Handling ease and comfort to lighten the load of a day's work. And more power than ever! Two great Valve-in-Head engines—the Loadmaster 105 h.p. and the Thriftmaster 92 h.p.—make these the most powerful trucks Chevrolet has built! Yes, these new jobs bring you peak value—and at a low price. They cost surprisingly little to buy, to run and maintain. That's why Chevrolet trucks outsell them all!

CHEVROLET MOTOR DIVISION, *General Motors Corporation*, DETROIT 2, MICH.

AHEAD WITH ALL THESE PLUS VALUES

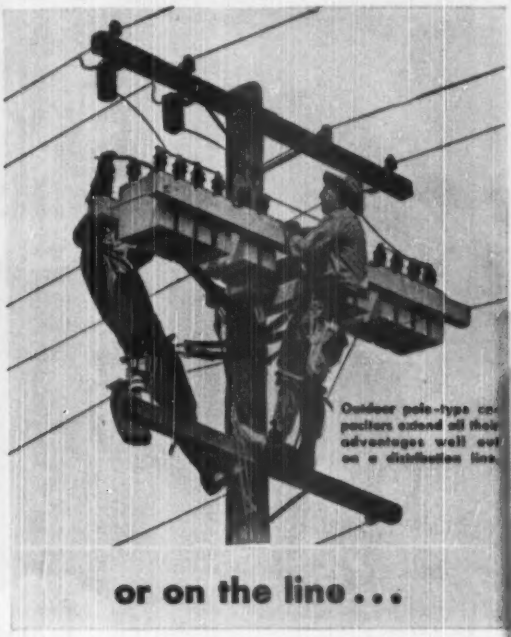
• TWO GREAT VALVE-IN-HEAD ENGINES: the New 105-h.p. Loadmaster and the Improved 92-h.p. Thriftmaster—to give you greater power per gallon, lower cost per load • THE NEW POWER-JET CARBURETOR: smoother, quicker acceleration response • DIAPHRAGM SPRING CLUTCH for easy action engagement • SYNCHRO-MESH TRANSMISSIONS for fast, smooth shifting • HYPOID REAR AXLES—5 times more durable than spiral bevel type • DOUBLE-ARTICULATED BRAKES—for complete driver control • WIDE-BASE WHEELS for increased tire mileage • ADVANCE-DESIGN STYLING with the "Cab that Breathes" • BALL-TYPE STEERING for easier handling • UNIT-DESIGN BODIES—precision built.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Three 900-kvar equipments, throat-connected and automatically switched in three steps in response to voltage level.

At the substation . . .



Outdoor pole-type capacitors extend all their advantages well out on a distribution line.

or on the line . . .

Make way for the Payload!

Capacitors provide the lowest-cost method of gaining extra circuit capacity . . . and now cost less than ever before . . . in some ratings as low as $3.60 per kvar. So, *now* is the time to make way for the payload . . . to release wasted circuit capacity for more kilowatts. And in the complete line of Westinghouse Inerteen Capacitors, you'll find the right equipment for the job.

From individual unit installations on primary distribution lines, to completely housed equipments for substation banks you can be *sure* of better performance with Westinghouse Capacitors—whether the application be power-factor correction, voltage control or reducing line and equipment losses. But, for any application, check first with Westinghouse.

Our years of close co-operation with utilities have given us broad experience in applying capacitors to many conditions. We'd like to apply it to your problem.

For complete information call your local Westinghouse office, or write for Booklet B-4343. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-60717

GET THESE TIME-PROVED FEATURES

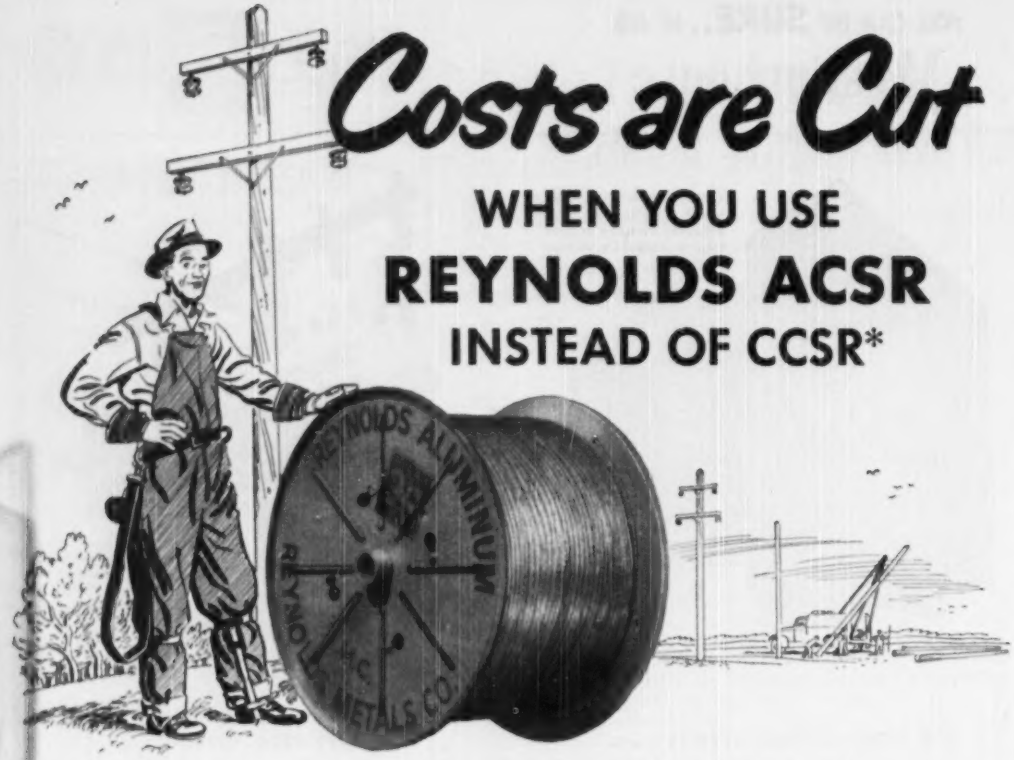
- **Inertex Insulating Paper**
- **Inerteen Impregnation**
- **Solder-Sealed Porcelain Bushings**
- **Durable, All-Welded Steel Cases**
- **Weatherproof Zinc-Spray Finish**

Westinghouse

CAPACITORS

Costs are Cut

WHEN YOU USE REYNOLDS ACSR INSTEAD OF CCSR*



*COPPER CABLE, STEEL-REINFORCED

FIGURE your overhead line costs on *all* counts—and on every one you'll find Reynolds ACSR comes out ahead, in *your* favor.

For example, #4-7/1 Reynolds ACSR lines cost *less per mile* to build than electrically equivalent #6 CCSR—*less*, even, than electrically smaller #8 CCSR. Savings as great as $90.00 per mile are possible on a typical ACSR installation!

When it comes to dependability of service, Reynolds ACSR again takes the honors! Reynolds construction—with aluminum completely protecting the strength-giving steel strands gives protection against abrasion, burning and deterioration.

Whether you figure it in cost per mile or in efficient, dependable service, first get all the facts about Reynolds ACSR. You'll see how Reynolds makes savings all along the line. Send for complete information. Write to Reynolds Metals Company, Louisville 1, Kentucky.

ACSR MANUAL FOR ENGINEERS

Contains helpful information, complete charts and tables. Free when requested on business letterhead—write to Reynolds Metals Company, Louisville 1, Ky.

WHY REYNOLDS ACSR IS SUPERIOR TO CCSR*

This cross section of CCSR shows how the thinly veneered steel strand is exposed to the elements.

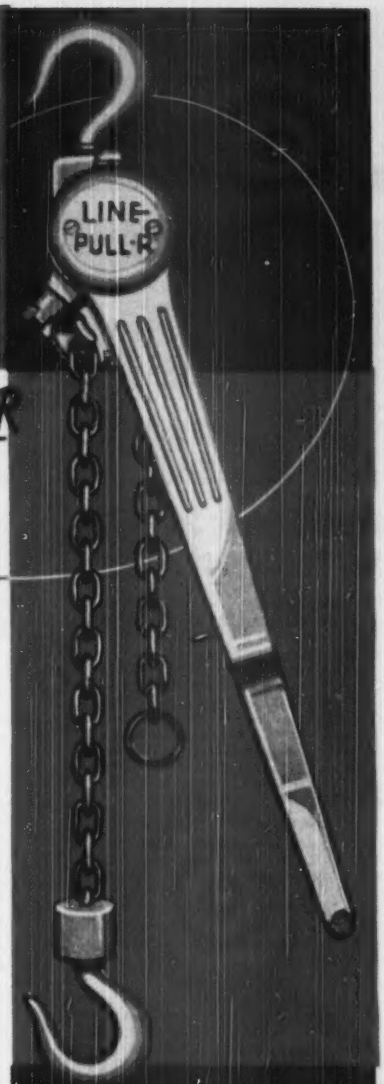
In Reynolds ACSR the strength-giving steel strand is completely protected by rust-free, corrosion resistant aluminum.

REYNOLDS METALS

REYNOLDS *Lifetime* **ALUMINUM**

CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

For *ANY* Pulling or Lifting Operation use the New Improved KEARNEY Line Pull-R



DO THE JOB BETTER - FASTER

This light weight (aluminum alloy) low cost utility tool is designed to handle almost any pulling or lifting job efficiently. By eliminating dangerous, slow, makeshift methods, it pays for itself and increases the safety factor on any job. The mechanism and automatic brake are fully enclosed and lubricated for life. This versatile tool is available in capacities from ¾ to 6 tons. For complete information including weights, sizes and prices, write for Bulletin No. 18-45.

KEARNEY Hi-Dielectric Rope

DEVELOPED SPECIFICALLY FOR THE POWER AND TELEPHONE INDUSTRIES

By a special treatment of individual fibre *before* stranding the high tensile strength of pure Manila fibre is maintained and longer service life is assured.

Dry samples of Kearney Hi-Dielectric Rope withstand 100,000 volts per foot for 5 minutes without evidence of heating or deterioration. Comparative tests show the wet electrical resistance of Hi-Dielectric Rope to be 20 to 30 times that of untreated rope. Higher dielectric strength when wet results from the resistance to moisture of the impregnated fibres. Less moisture absorption also means longer service life through the elimination of mildew and rot. Kearney Hi-Dielectric Rope contains no ingredients injurious to the hands.

Write for complete information on Kearney Rope, including Safe Load values and proper care and maintenance.

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue
St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

JAMES R. KEARNEY

BETTER CONSTRUCTION *Safer* MAINTENANCE

WIRING NEWS

A PERIODICAL DIGEST OF WIRING IDEAS FROM THE GENERAL ELECTRIC CONSTRUCTION MATERIALS DEPARTMENT

Master Selector Switch Adds New Remote Control Uses

Have you stopped to consider the amazing versatility added to General Electric's remote-control wiring system by the master selector switch?

Replacing gangs of separate ON and OFF controls, the compact master selector switch, RMS-1, provides instant, positive control of up to nine different circuits.

You'll do well to use it as an added talking point in arousing *even more interest* in remote control. Point out how one or more master selector switches can provide advantages such as these:

In Homes and Apartments

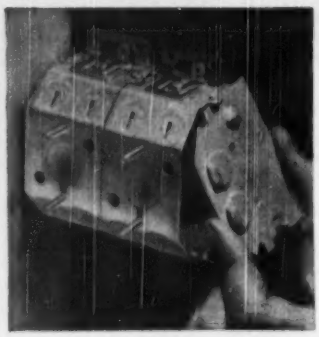
Instant bedside control of all interior and exterior lighting in case of emergencies. Added convenience through control of kitchen appliance outlets and attic ventilators from several different points. Control of key indoor and outdoor lights from the garage, front door, back door, and bedroom.

In Plants and Factories

Control of fire and alarm circuits. Control of watchman's circuits and provision for pathway lighting on his rounds. Selective control of aisle lights, individual work area lights, outlets, and small electrically-operated machinery from any desired point.

Then too, there are many applications for farms, swimming pools, parking lots, athletic fields, tourist cabins, schools, museums, hospitals—and you can probably think of many more. For further information simply check box (A) below.

New Levelock Switch Box Can Take Punishment



Neither hammer blows nor construction-site abuse can dislodge the side plates of the new General Electric Levelock switch box. Wedging action of a new locking mechanism locks box parts securely in place—yet is simple enough to permit fast, certain assembly of switch-gangs.

Leveling the box against the studding is also a faster, easier operation. Four contact points—instead of the usual three—prevent tilting or rocking of box during nailing.

In addition to nail-through holes, an extra set of nail holes through the side plates allows speedy gang mounting of the Levelock box direct to studding. Extra side-plate pryouts provide for out-of-the-ordinary installations. All pryouts are easily removed by a quick twist of a screwdriver.

A new single-screw ear adjusts from slightly above to $\frac{1}{16}$-inch below the edge of the new Levelock box, while an extra-sturdy bridge across the ear adds increased strength. There's plenty of space, too, within the bridge to accommodate the device strap.

The ingenious construction of General Electric's Levelock saves time when used on either new construction or modernization work. Builders and contractors will appreciate your telling them about the Levelock box, so check box (B) in the coupon for complete information.

For Direct Burial—Versatol-Geoprene Cable

For underground wiring of industrial power circuits, park or airport lighting systems, farm wiring, and a wide variety of other applications, you'll find General Electric Versatol-Geoprene trench cable a perfect solution.

By combining a tough Geoprene jacket with Versatol® insulation, a trench cable of superior quality is provided. Developed specifically for direct burial in the earth—yet suitable for use in duct or conduit installations—long lived G-E Versatol-Geoprene trench cable is stubbornly resistant to the attacks of moisture, soil acids, alkalies, and abrasion. Simple to install, G-E Versatol-Geoprene trench cable offers economical installation and long service life.

Available with one, two, or three conductors in a wide range of sizes, G-E Versatol-Geoprene trench cable meets practically every underground wiring requirement. G-E Versatol-Geoprene cable is listed by Underwriters' Laboratories, Inc., and is also listed as Type A of CAA specification L-824 for airport lighting in Awg sizes No. 10 solid through No. 4 stranded. For further information, check box (C) in the coupon.

New Hung Ceiling Box*

For fast, easy installation and real savings on jobs using conduit, this new hung ceiling box is hard to beat. Virtually eliminating special couplings and pipe bending operatings, this easy-to-handle, eight-sided ceiling box allows conduit to enter the knockout—over the grid structure—from all eight angles. In addition, the lower row of knockouts permits conduit runs parallel to channels.

Four-point suspension of the box is provided by two sturdy mounting bars. With bars in a parallel position, the box slides back and forth for quick, easy centering. When spread slightly, the box locks securely into any desired position for easy wiring.

For long life and utmost protection against corrosion, the new hung ceiling box has been hot-dipped galvanized. For full particulars check box (D) in the coupon.

(*U. S. Patent No. 1,934,481)

Section K-12-827

Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut

- ☐ A—Remote-control Master Switch
- ☐ B—Levelock Switch Box
- ☐ C—Versatol-Geoprene Trench Cable
- ☐ D—Hung Ceiling Box

Name _____ Title _____

Company _____

Address _____

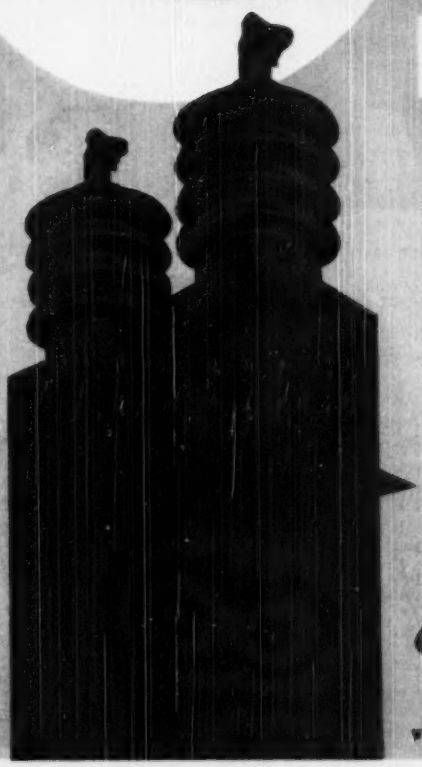
City _____ Zone _____ State _____

GENERAL ELECTRIC

SPECIALIZATION PAYS DIVIDENDS . . . when utilities install

A 2,400 Kvar 12,470 Volt, WYE, isolated neutral, C-D installation consisting of 168 single banking, 15 Kvar, 7,200 volt rack type capacitors, in an outdoor, weather-proof housing, with temperature-controlled, forced ventilation.

CORNELL-DUBILIER CAPACITORS FOR POWER-FACTOR IMPROVEMENT



That C-D specialization pays dividends is proved by the more than a decade of trouble-free field service delivered by C-D capacitors. It's the kind of equipment you can install and forget, proving once again that *the specialist does it best.* Next time specify C-D—the better capacitor. A C-D field engineer will be glad to discuss with you capacitors designed for your specific power-factor improvement needs. Your inquiry is cordially invited. Catalog on request. Cornell-Dubilier Electric Corporation, Dept. D-80, South Plainfield, New Jersey. Other plants in New Bedford, Worcester, Brookline, Mass.; Providence, R. I.; Indianapolis, Ind. and Cleveland, Ohio.

Follow the leaders
Demand dependable C-D Capacitors—built by capacitor specialists.

C-D Best by Field Test!

CORNELL-DUBILIER CAPACITORS 1910 1950 Reg. U. S. Pat. Off.

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

ADJACENT CHANNEL OPERATION

New "Uni-Channel" Top performer in low-cost 2 way radio

UNI-CHANNEL SENSICON DISPATCHER — DASH MOUNT OR TRUNK MOUNT (Not Illustrated)

...with the marvelous Sensicon circuit...

...for *permanent selectivity*—and 8 other Motorola improvements—Count on Uni-Channel through any routine or emergency to handle *whole* messages in heavy adjacent channel traffic (±35 Kc. at 100 db. down, and ±15 Kc. at 6 db. down)—your practical proof of superior *Motorola* equipment!

A marvel of mechanical convenience in one compact and accessible package. Just 4 screws install it in any vehicle. Or, as an emergency station, simply connect antenna* and power.* Investigate Uni-Channel before buying.

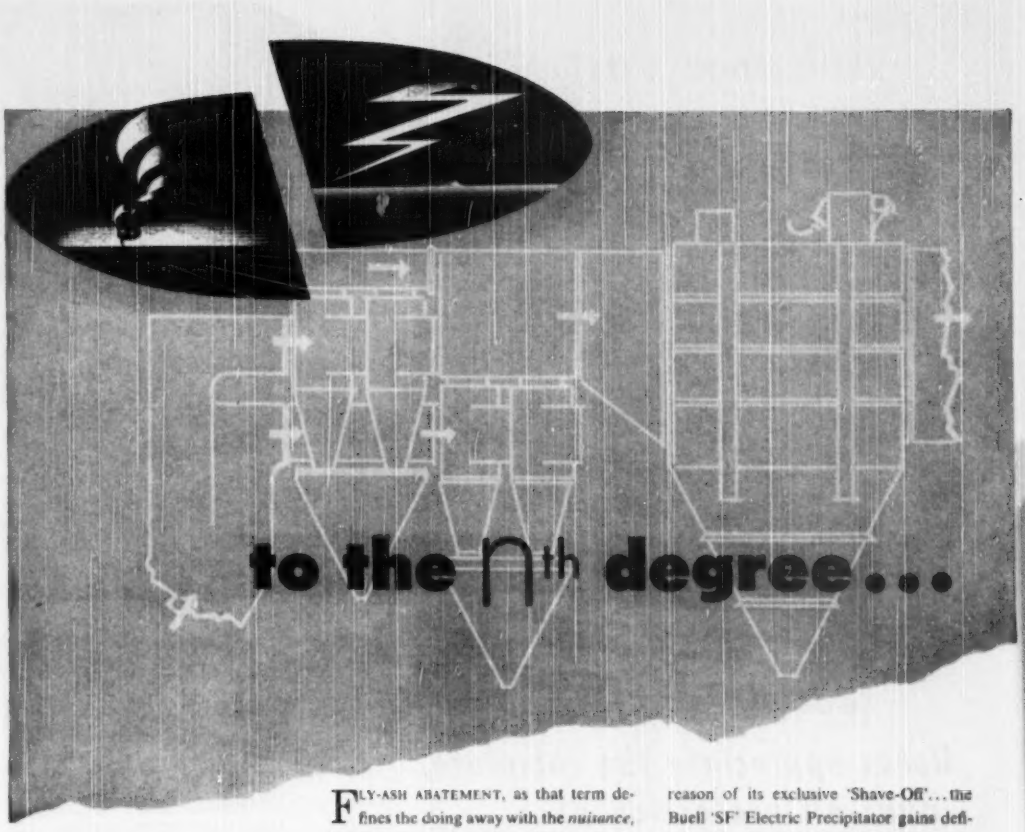
FM 2-WAY RADIO

BY THE WORLD LEADERS

BACKED BY 20 YEARS RESEARCH, EXPERIENCE, AND SPECIALIZATION IN MOBILE RADIO

Motorola

COMMUNICATIONS DIVISION 4545 AUGUSTA BLVD., CHICAGO, In Canada: Rogers Majestic, Ltd., Toronto



to the n^{th} degree...

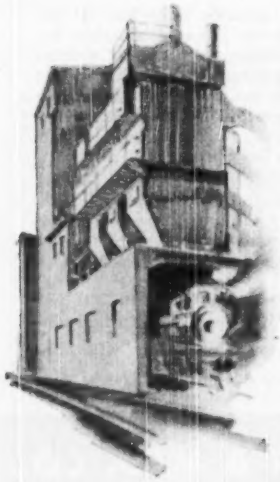
FLY-ASH ABATEMENT, as that term defines the doing away with the *nuisance*, is a call to positive action. What action is most positive, what combination of collectors most trustworthy, stands well proved among engineers—and in the court of public opinion.

Management's purpose to take most positive action is served to the n^{th} degree by a Buell 'SF' Electric Precipitator, in tandem with matching-capacity Buell van Tongeren Cyclones.

To the equipment phase of planning, Buell today offers designs based on world experience in both Precipitator and Cyclone dust collection. The Buell van Tongeren Cyclone excels in practical effectiveness by reason of its exclusive 'Shave-Off'... the Buell 'SF' Electric Precipitator gains definite operating advantage through such design features as StediFlow dust-fall.

To the engineering of such an installation, Buell brings the broadest consulting experience in high-efficiency dust collection—and a notable forth-rightness in predicating operating guarantees on attainable fractional efficiencies.

Buell engineers will welcome the opportunity to confer on basic problems or on the details of equipment. Literature for preliminary study on the collection of nuisance dust on request. Write Buell Engineering Company, 70 Pine Street, Suite 5050, New York 5, N. Y.



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Engineered Efficiency in **Dust Collection**

2300-4600 VOLT

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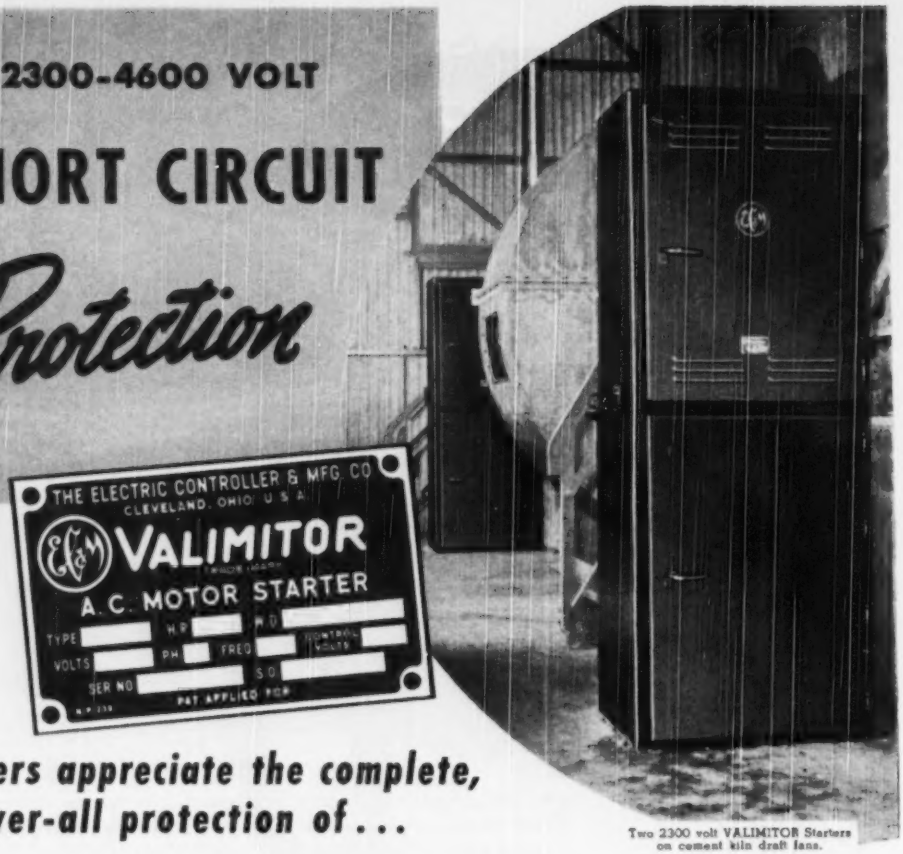

Two 2300 volt VALIMITOR Starters on cement kiln draft fans.

Users appreciate the complete, over-all protection of . . .

EC&M VALIMITOR (volt-ampere-limitor) STARTERS

There are no unprotected blind spots with EC&M VALIMITOR Motor Starters. No lapse in protection between the operating values of fuses and the interrupting capacity of the starter—no danger that such a fault will damage motor, wiring, or starter—and no chance that an increase in available KVA will cause the starter to become outmoded. *Continuous protection under all conditions is an inherent feature of EC&M 2300-4600 volt VALIMITOR Motor Starters.*

It is perfectly safe to use EC&M VALIMITOR Starters for any squirrel-cage, wound-rotor, or synchronous motor within their maximum ratings because these starters have high thermal capacity to withstand frequent starting. Their heat inertia is equal to or greater than that of the average motor. They are likewise suitable for use with high-inrush motors. And when a short occurs, there's nothing to replace. Fault currents are interrupted directly by the well-known Type ZHS heavy-duty Magnetic Contactor used in the starters—the maximum fault current being limited to 25,000 KVA or less (steady state current).

CUSHIONED STARTING is another inherent feature of EC&M Full-Voltage VALIMITOR Starters. The degree of reduced voltage starting provided by these across-the-line starters will often eliminate the need for a VALIMITOR Starter of the reduced voltage type. After the motor is up to speed, these Full-Voltage VALIMITOR Starters function like any standard across-the-line starter.

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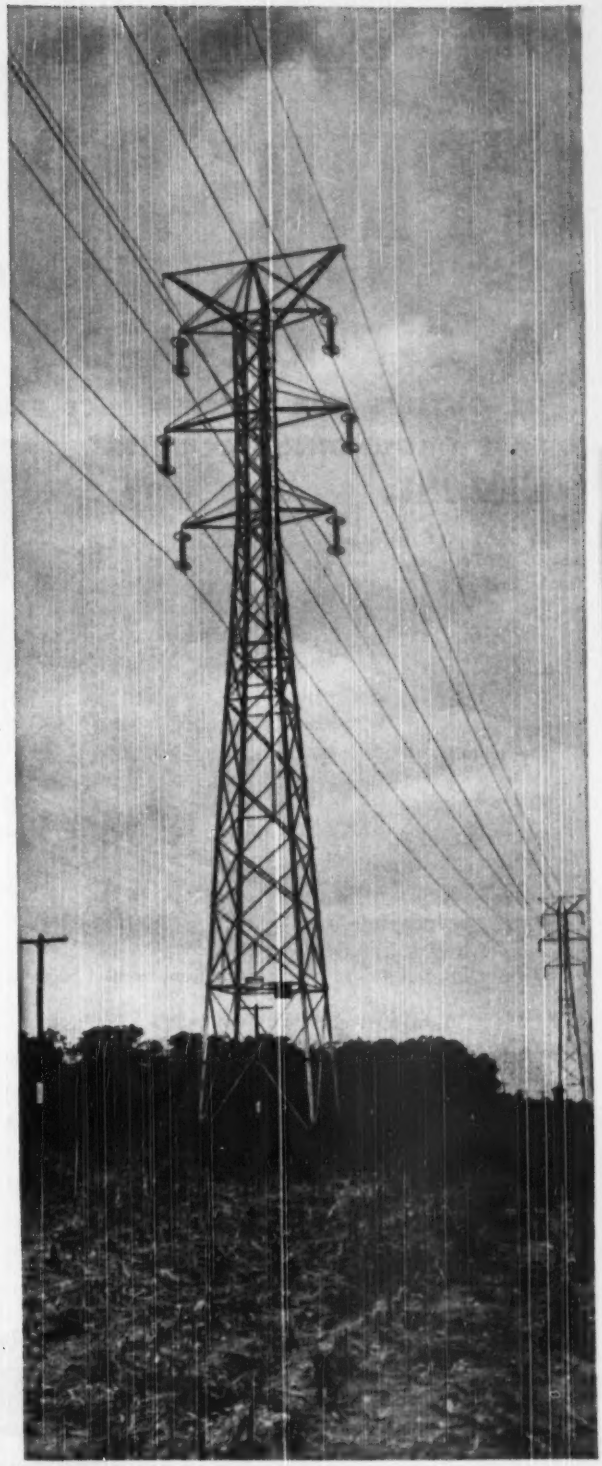

These double-circuit narrow-base 132-KV suspension towers were designed and fabricated by Bethlehem for the Public Service Electric and Gas Co., Newark, N. J. Conductors, 795,000 cm A.C.S.R.; ground wire, 190,800 cm A.C.S.R.; normal span, 500 ft; height, 111 ft; base width, 14 ft, to fit narrow right-of-way.

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EVERYTHING IN WIRING POINTS TO

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Improved Industrial Efficiency

"IN THE SENSE of having plenty of activity, in fact too much, the business outlook could hardly be brighter. But in the sense of maintaining a way of life, and personal freedom, the business outlook is about on a par with the current military outlook in Korea." This is a recent observation of Dexter Keezer, McGraw-Hill economist and author of *Making Capitalism Work*.

The danger which Keezer sees ahead is the clear prospect of having our system of business enterprise controlled to death in the years ahead. Although the amount of conversion to military production is only in the neighborhood of 10% of our capacity to produce, it is going to provide an excuse for all kinds of controls.

The problem facing all industry is then—How can we provide the necessary war material without dislocating the entire economy? The obvious answer is—more production. Of course, increased hours of work, more employment, and less featherbedding could go a long way toward achieving this result. But in the end we must do it by improving our equipment and processes so as to step up military production to match the volume sought by the government and provide for civilian demands as well.

The strategic position of the electrical industry is immediately obvious. It is this industry's manufacturers, utilities, and engineering consultants who can provide the tools, the know-how, and the electric service to secure the increased production that is required. Through their combined efforts, industrial efficiency can be raised to maintain the necessary state of military preparedness and the high standard of living along with a free economy.

The electrical manufacturers can make their contributions through increased research and development and more effective selling of the techniques and equipment which they create. The electric utilities can provide their power salesmen to service the industrial customers. Engineering consultants are daily becoming more important in this field.

As history has proven, there is no end to the improvements in manufacturing techniques that can be applied in all industries. Better lighting, uses of electric heat, materials-handling equipment, and higher speed machinery still provide many opportunities for increasing industrial efficiency. But in addition to this we have the need for better electric distribution systems within the plant, more capacity, and adequate control equipment. All of these fall within the scope of the activities to which the industry can devote itself.

The improvement of America's productive capacity is clearly identified with the preservation of the free enterprise system. Knowing this there is only one course to follow. The industry must redouble its efforts toward the goal of improved industrial efficiency.

SEC Should Act Now

A FEW MONTHS AGO one of the moderate-sized utilities of this country was selected to receive the coveted Coffin Award. This award is for outstanding accomplishments in the field of utility management. The winner is selected by the most talented and expert representatives from the electric utilities. The panel is made up of EEI committee chairmen covering engineering, commercial activities, accounting, rates accident prevention, and industrial relations.

Almost simultaneous with the presentation of the award, which went to the Washington Water Power Co, the management of the American Power & Light Co took steps to restrict the officers of WWP in carrying out their managerial activities. That is to say, the vote of confidence given the company by the industry was countermanded by American's board of directors. They dropped all but two of the directors of Washington representing local management and put non-resident members in their place.

It is this kind of activity along with efforts to justify the continued life of American that causes concern and tends to endanger the continuance of investor-owned utilities in the Northwest. Attempts have been made by stockholders of American and by the Washington and Idaho Commissions to secure the liquidation of American. But so far the Securities and Exchange Commission has failed to act.

It now appears that the whole intent of the Holding Company Act is being circumvented, not only through a continuance of the ownership of Washington Water Power but by the destruction of local management in the affairs of the company. It is time for the Securities and Exchange Commission and the stockholders of American Power & Light Co to take final steps to rectify this unnecessary and undesirable condition.

Interconnect Before the Bombs Come

ANOTHER WORLD WAR may be on its way. If it comes, the United States may be bombed. Then, as never before, our country will need an electric utility system interconnected from coast to coast and from border to border.

Today most of our utility systems are interconnected. And rapid progress is being made where new ties are needed.

Detroit Edison Co and Consumers Power Co have new facilities permitting an interchange of 100,000 kw between the two companies. This is in addition to an existing 50,000-kw interconnection.

Arkansas Power & Light Co is building two large transmission line ties at a cost of $1 million. It was recently announced that the Pennsylvania Electric Co and Metropolitan Edison Co had completed a 114-kv, 70,000-kw tie from Erie, Pa., on the west to Easton, Pa., on the east. This brings Penelec into the Mid-Atlantic power pool. These are only samples of the vast program of the utilities now going forward. The Bonneville power system in the Northwest has plans to go as far as southern Oregon, southern Idaho, and eastern Montana. Electric co-ops are rapidly integrating their facilities through existing or new transmission systems.

Some interconnections are tending to duplicate existing facilities, but considerable success has been recorded in eliminating this wasteful procedure. The recent agreement between SPA and the Oklahoma companies was an important step in this direction. Certainly, during an emergency like this, duplication of power lines for any reason has no place in our economy.

There are still those cases where interconnections that would result in the flow of power over state lines are not made. Fortunately, there are few cases where such power flow can be construed as a sale rather than interchange of energy. Any limitations on the free flow of power must be eliminated at an early date. If Federal Power Commission regulation is a factor, such restraints should be immediately eliminated through commission and industry consultation and mutual action. If connections are of doubtful economic value, they should be considered from the national defense point of view before abandonment.

We are not proposing that a single uneconomic interconnection be constructed in the name of national defense. But we do believe that all potential opportunities for savings and further security of power supply should be studied with the utmost urgency.

Cooperation for Safety

SAFETY OR FREEDOM from danger is a fundamental precept in the design and operation of electric power systems. But even with the emphasis that is placed upon this problem, the electrical utilities are a long way from their objective.

An outstanding contribution to the appreciation of the problem and the responsibility for its promotion was made by the Conference Committee on Labor-Management Cooperation for Safety. The following set of general principles is worthy of attention by the industry—both labor and management:

1. Safety primarily is the legal and moral obligation of the employer.

2. Cooperation in the safety program is the moral obligation of each individual employee.

3. In unionized plants the welfare of the employees places upon the labor union a moral obligation to cooperate in accident prevention, within the framework of its agreed-upon participation.

A more detailed statement of principles has been published by the Conference Committee. This statement has been accepted by the President's Conference on Industrial Safety. The conference was composed of leaders of American business, labor, insurance, educational, and private safety organizations.

The Electrical Week

Power-short Alaska is to get its first big hydroelectric project. At Eklutna Lake near Anchorage the Department of Interior plans to build a 30,000-kw plant. President Truman has asked Congress for $1.1 million to start construction (p 62) . . . The Korean situation has led Interior Department officials to consider a two-way expansion of its power program. 1. What projects can be speeded up? 2. What projects can be urged for the national defense? (p 65) . . . Puget Sound Power & Light Co has been authorized by the Federal Power Commission to make additional emergency interconnections but was denied blanket approval for interconnections (p 66) . . . Electric operating revenues of Class A and B privately owned electric utilities in the United States were 9.8% above June, 1949. Net income was up 14.4%, according to FPC (p 66) . . . Reclamation and the Public Service Co of Colorado have signed a "wheeling type" contract which has been approved by Interior Secretary Chapman (p 67) . . . Electric utilities do not want to be absolved from paying excess profits taxes. But they believe that such a law should make allowances for "peculiar regulatory and economic conditions" under which they must operate (p 68) . . . And for the fifth consecutive week energy output set a new record, 6,369,830,000 kwhr in the week ended Aug 19 (p 69).

• • •

Biggest headache for aluminum producers at the moment is manpower not electrical power. The aluminum industry is finding it difficult to recruit foundry workers.

Speculation about the site for the new H-Bomb plant (EW, Aug 14, p 71) now centers on the Southwest, with Arkansas making a strong bid for the project.

To make a million tons of steel castings the industry uses 300,000,000 kwhr of electric energy.

Federal Power Commission maps and classified documents are now stamped with a statement that they contain "information affecting the national defense of the United States within the meaning of the Espionage Act." The statement concludes that "its transmission or revelation of its contents in any manner to an unauthorized person is prohibited by law."

The electrical energy excise brought in $85,703,833.44 during the fiscal year ended last June 30. That's a jump of more than $6.3 million over the previous fiscal year, in contrast to declining collections for most other excises. Appliance sales produced only slightly less tax revenue during fiscal '50, but light bulbs and tubes dropped off sharply—to $20,725,712.60, more than $6.3 million less than in the previous fiscal year.

In the week ended July 29 Pacific Gas & Electric Co had a record peak demand of 2,519,000 kw but still had a reserve of 476,000 kw, a margin of 19%.

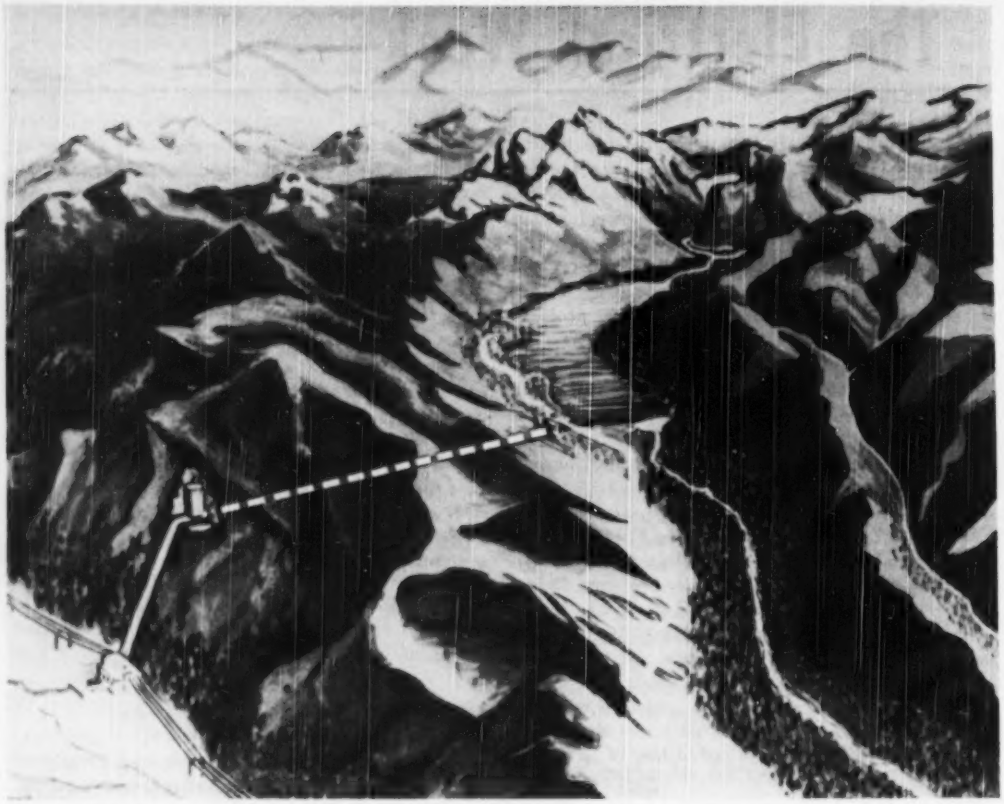
June sales by electrical goods wholesalers were up 1% over May, but a whopping 15% over June, 1949. Bureau of Census figures show this year's sales for the first half were 8% above last year's first six months.

Sixty-six employees of Public Service Electric & Gas Co, Newark, have completed 50 years of service since the company began recognizing such service in 1925. Of the 66, there are still 13 on the payroll, 26 are getting pensions, and 27 have died.

Industrial power users took over half (11,925,076,000) of the 23,383,026,000 kwhr sold in June. This was an increase of 17.4% over June of 1949. Residential users bought 5,712,679,000 kwhr or 14.1% more than a year ago.

Notes From The News

Seattle City Council has appropriated $79,000 in City Light bonds to cover engineering and legal expenses in connection with the proposed purchase of Puget Sound Power & Light Co properties. In all, the city has spent $250,000 in preparing the purchase proposal for a vote . . . Virginia Electric & Power Co has the highest assessment value ($57,264,000) of any corporation in Virginia . . . Kelso, Wash., has opposed for the second time the construction by Tacoma of two hydroelectric dams on the Cowlitz River upstream from Kelso. The river has been declared a fish sanctuary by the state, but the Korean situation is causing sentiment favoring Tacoma's construction of the dams . . . A General Electric official has declared that by the end of 1950 1 out of every 17 persons in the U. S. will have a television set, making a total of 9 million sets in operation by the end of the year. On the West Coast the Electric League of Los Angeles, Inc, reports 642,897 TV sets in the Los Angeles area as of the end of July. In Los Angeles County there is one set for each 2.4 families . . . A peak-to-peak microwave relay system transmitting television programs between Los Angeles and San Francisco will begin operation Sept 15. At first the system will carry television only, but later it will carry long distance phone calls as well.



ARTIST'S CONCEPTION of Eklutna hydroelectric project shows the low dam, diversion tunnel, penstock, and the power plant which is to be constructed at the foot of the mountains. Engineers consider the project as relatively simple, a factor that will cut its cost

Alaska to Get First Big Hydro Project

30,000-Kw Plant Will Be Erected at Eklutna Lake; Anchorage and Matanuska Valley to Benefit; Truman Asks Funds for Construction

ALASKA is to have its first large-scale hydroelectric development. At Lake Eklutna, near Anchorage, the Department of Interior will build a 30,000-kw power plant. Total cost is estimated at $20,365,400.

President Truman on July 31 signed the bill providing for the project. One of the purposes was stated to be "to further the self-sufficiency of national defense installations" in the area. The President has since asked Congress to approve a supplemental appropriation of $1.1 million for the current fiscal year to begin construction. The Bureau of Reclamation expects to call for bids early next year, and it is believed that the plant will be in operation by June, 1955.

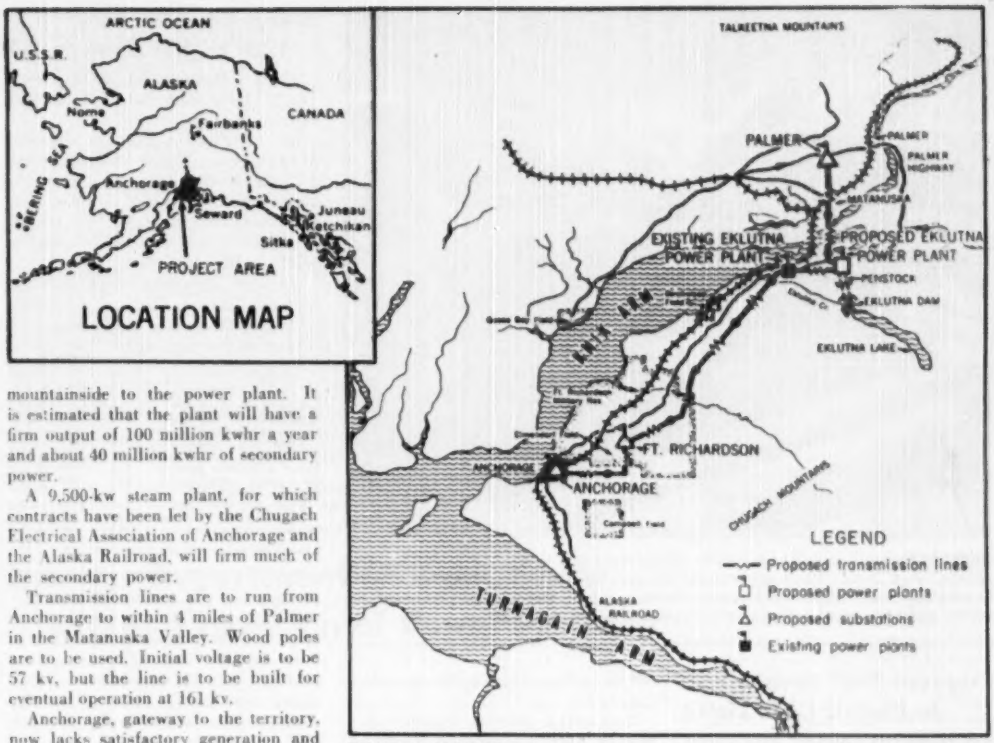
The project will serve Anchorage, Alaska's largest city (population 26,000), the Matanuska Valley, three cooperatives, the Alaska Railroad, Elmendorf Airfield, Fort Richardson, and the town of Palmer.

Municipalities, cooperatives, and government agencies will be preference customers for the power.

Alaska's first public power project will be on a site halfway between rapidly-growing Anchorage and the Matanuska Valley, the territory's most productive agricultural region.

More than 800 ft above sea level Eklutna Lake is a natural reservoir, 7 miles long by 1 mile wide, with a maximum depth of 200 ft. Power production plans call for boring a tunnel through the mountains, installing a surge tank and penstock down the mountain side, and building the plant near "tidewater level."

Water from the lake would be diverted through a 4.5-mile tunnel, 9 ft in diameter. The tunnel would enter Goat Mt and extend to the other side of the mountain range. A concrete surge tank, 96 ft high, near the tunnel outlet would act as an escape valve. A steel penstock, 7.5 ft in diameter and 1,250 ft long, would carry the water down the



EKLUTNA PROJECT, small map at upper left, will affect but a small portion of Alaska's 586,400 sq miles. Large map shows location of the project and area which it will serve

mountainside to the power plant. It is estimated that the plant will have a firm output of 100 million kwhr a year and about 40 million kwhr of secondary power.

A 9,500-kw steam plant, for which contracts have been let by the Chugach Electrical Association of Anchorage and the Alaska Railroad, will firm much of the secondary power.

Transmission lines are to run from Anchorage to within 4 miles of Palmer in the Matanuska Valley. Wood poles are to be used. Initial voltage is to be 57 kv, but the line is to be built for eventual operation at 161 kv.

Anchorage, gateway to the territory, now lacks satisfactory generation and distribution facilities. The Anchorage Power & Light Co built a 1,000-kw plant at Eklutna in 1927, added a second 1,000-kw unit in 1936 and a 700-kw diesel-driven generating unit before the war. The city took over the company in 1943 and is operating it under the name of Anchorage Public Utilities. Before the Eklutna project can be started Reclamation must acquire title to this plant and also the city's water rights.

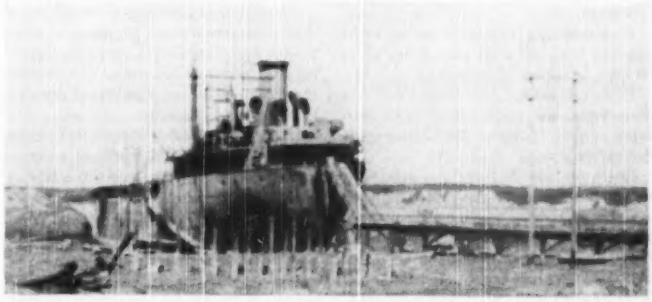
Power supply has been so tight that in 1947 the city purchased the stern half of a disabled tanker and has been utilizing its boilers and generating equipment as a power plant. Two 1,000-kw diesel-driven generators have been added and a third purchased.

The distribution system in Anchorage was designed to serve a population of 3,500. Now the system is trying to serve eight times as many persons. Demand is so great that circuit breakers are alternately opened on various sections of the city's power system, thereby depriving other sections of electricity.

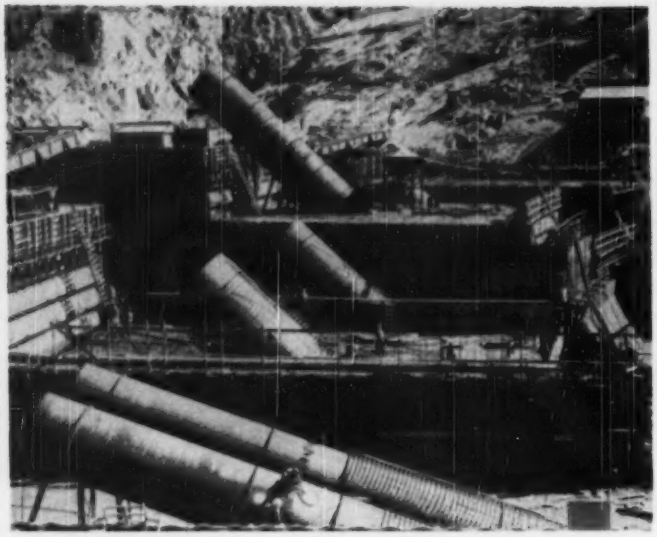
Some 3,000 persons in the city's suburbs are without electric service for their newly constructed homes. Some of these will be served by the Chugach co-op which is installing a 1,700-kw diesel plant for operation this fall.

Present power rates in Anchorage are exorbitant in comparison with those in the United States but are reasonable in comparison with those elsewhere in the territory. A monthly bill for 100 kwhr in 1948 (latest figure available), was $6.93. At that time it was estimated that fuel oil cost alone was nearly 1¢ per kwhr. Plant equipment and labor are also more costly than in the United States. When the Eklutna plant is in operation, it is believed that the bureau will be able to sell Anchorage energy for 0.75¢ per kwhr.

Since it is estimated that power capacity of the Eklutna project would be fully utilized in the second year following its construction and since practically all Alaska communities are short of power, studies are being made to develop the water resources of the Kenai Peninsula and of the Matanuska, Susitana, and Nenana Rivers. In 1948 the territory's non-military generating capacity was only about 71,000 kw. The total for military installations is not known but is not sufficient to bolster civilian supply.



S.S. HACKETTS, Anchorage's last resort to get power for its growing population



PENSTOCKS and river outlet tubes at the Hungry Horse Dam in Montana as they appeared recently. Each of the 13½-ft-dia penstocks will carry 80 tons of water a second from the 34-mile-long reservoir behind the Bureau of Reclamation Dam. The river outlet tubes will permit the dam to be used for flood control. Plant capacity will be 285,000 kw

Proposed 1951 Revisions to Electric Code Listed

A bulletin of proposed 1951 amendments to the national electric code has been issued by the Electrical Section of the National Fire Protection Association. It is entitled "Proposed 1951 Amendments to the National Electrical Code—Second Printing, Appendix "A," 1950 Correlating Committee Report, Revised."

Two new articles are listed for inclusion: Article 351—"Liquid-Tight Flexible Metal Conduit" and Article 665—"Induction and Dielectric Heat Generating Equipment."

Many of the proposed code revisions are editorial in nature and for clarification purposes.

Some other significant revisions and additions are:

Disconnecting switch is to be rated not less than 60 amp, circuit breakers 50 amp (Article 230-Services).

Circuit breakers 0-30 amp class and plug fuses for residences to be time delay type (Article 240-Overcurrent Protection).

Provisions are included for side wall and roof surface of vaults constructed of hollow tile, also using building walls and floors as part of vaults (Article 450-Transformers and Transformer Vaults.)

Equipment is to be approved for location and specific gas, vapor, or dust that will be present (Article 500-Hazardous Locations).

High-voltage grids as a part of electrostatic spraying or detearing to be protected against spark-over and accidental grounding (Section 5003-a-Paints, Lacquers, and Finishes).

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Commerce Given Power Controls in Senate Bill

Secretary of Commerce Sawyer would administer all priorities and allocations, including electric power controls, under the amended version of the Defense Production Bill passed Aug 21 by the Senate. The amendment, introduced by Sen Edwin C. Johnson, Colorado Democrat, was passed 47 to 42. The bill was then sent to Conference Committee.

The Johnson amendment would upset Administration plans to place electric power and fuels authority with Secretary of Interior Chapman. The amendment can still be eliminated by the Conference Committee.

Other Senate amendments included a provision that the President or a designated federal agency be given a 30-day notice of any general rate increase by utilities. Sen Lister Hill, Alabama Democrat, who sponsored the amendment, said it was to give the Rural Electrification Administration an opportunity to testify on the effects of any proposed rate boosts on its co-ops.

Energy Sales for May 12.5 Higher Than in '49

Electric energy sales in May were 12.5% higher than those for the same month last year.

Edison Electric Institute reported May sales to ultimate customers were 22,394,246,000 kwhr, compared to 19,904,979,000 in May, 1949. Revenue from ultimate customers totaled $407,411,300 or 10.5% above the $368,669,800 received in May last year.

For the 12 months ended May 31,

Classification of Sales, May

Kilowatthour Sales May	Million Kwhr 1950	1949	Percent Change
Residential or domestic	5,235	4,464	+17.3
Rural (District rural rates)	634	627	+ 1.1
Commercial or industrial			
Small light & power	3,919	3,611	+ 8.5
Large light & power	11,300	9,958	+13.5
Street & highway lighting	206	190	+ 8.2
Other public authorities	581	509	+14.2
Railways and railroads			
Street and interurban	274	296	— 7.6
Electrified steam railroads	194	202	— 4.3
Interdepartmental	52	46	+12.2
Total to ultimate customers	22,394	19,905	+12.5

average use per residential customer was 1,754 kwhr. This was an increase of 8.5% over the average use of 1,616 kwhr for May, 1949. The average annual bill was $51.04, which was 6% higher than 1949's $48.16. However, revenue per kilowatthour dropped 2.3%, from 2.98¢ to 2.91¢.

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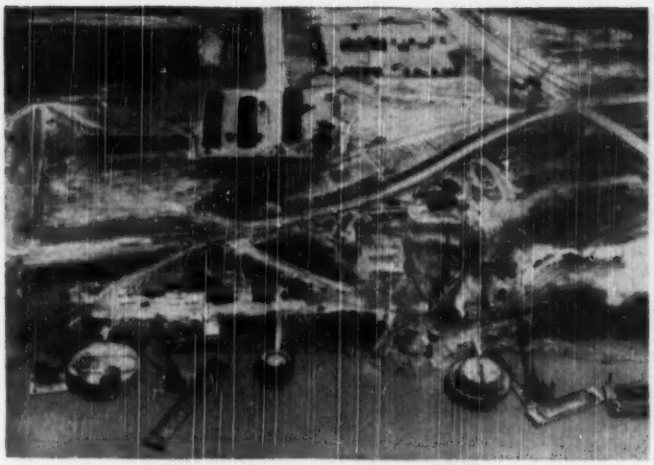
To Build 75,000-Kw Plant

Utah Power & Light Co plans to build a 75,000-kw plant in Salt Lake City. The plant, costing $10.5 million, will be an extension of the utility's 66,000-kw generating station being built on the west bank of the Jordan River, west of Salt Lake City. The plant is expected to go into operation in August, 1951.

Cattle Rustlers Using Home Freezers

A new market has been opened for home freezers. In San Diego County, California, "commercial" cattle rustlers find them useful. Stolen cattle are slaughtered immediately, cut up, and stored in freezers. In this way most of the evidence is destroyed. Another advantage is that the meat can be kept until the theft has been forgotten. The freezers also encourage other persons to steal their winter's supply of meat, police authorities claim.



FROM THE AIR construction work at Clermont Station of Cincinnati Gas & Electric Co may be observed. The 100,000-kw station is being built on the Ohio River east of Cincinnati

Interior Department Officials Study 2-Way Expansion of Power Program

INTERIOR OFFICIALS are considering a two-way expansion of the department's power program. Studies are being made to answer these questions.

1. Which projects under construction could be speeded up if it's decided that more federal power is needed for national security?

2. What new power projects could be urged as contributing to defense?

Thus far most of the studies are in preliminary stages. The Eklutna project in Alaska has been the only one approved (Page 62).

Interior proposals for new construction funds or power project authorizations will be screened by the Bureau of the Budget. If the bureau approves, the President will send them to Congress.

Meanwhile, Interior's power program has received a green light in the first official attempt to evaluate federal construction programs under the mobilization.

Acting on a general directive from President Truman July 21 to curtail public works not contributing to defense, Secretary Oscar L. Chapman has ordered a review of the department's construction program. Heading his list of criteria for judging water and power programs was the statement that power construction "will be continued undiminished . . . because of direct connection with national security." Only exception to continuing power projects will be "where the contemplated power production is purely incidental to other functions and of such small amount as to be unimportant in the current emergency."

Chapman's announcement meant that there would be no cuts in construction fund requests by Interior's power agencies, Bonneville Power Administration, and Southwestern Power Administration. (Southeastern Power Administration, established earlier this year, has not yet evolved any construction program.)

Reclamation power projects which will not bring in water by mid-1952 will be halted, Chapmen said. Hit by this ruling would be large parts of the bureau's irrigation programs for the Columbia River and the Missouri Basin. It could clip more than a fourth off the total of nearly $100 million being sought for Missouri Basin construction during fiscal '51.

Reclamation officials pointed out that stopping these projects now would mean even greater savings during the next few years when construction would be further advanced.

A bureau report reviewing its program under the new criteria has been submitted to Chapman. There was speculation, however, that some of the proposed economies might be protested by Congressmen from the Missouri and Columbia River regions who had supported the projects slated to be stopped.

Municipal and industrial water supply projects, general investigations and operations and maintenance were all rated essential to national security.

Where projects under contract are ruled unessential, Chapman said that work "will be terminated in an orderly manner designed to protect the government's investment and funds."

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Action on Niagara Plans by Congress Uncertain

Next moves were being awaited last week to determine whether Congress would act this session on redevelopment of Niagara Falls.

Both Niagara Mohawk Power Corp and New York's State Power Authority have said they'd like to handle the redevelopment, but the Senate has reserved the decision to Congress (EW, Aug 21, p 5). That prevents either the company or the power authority from seeking a Federal Power Commission license for the project.

The House Public Works Committee which held hearings on a bill introduced by Sen Herbert H. Lehman and Rep Franklin D. Roosevelt Jr, had indicated only that more hearings would be needed before the committee could act on the bill. And no decision had been made to hold further hearings. Under the Lehman-Roosevelt bill, the Army Corps of Engineers would construct the project, but the state would operate it.

•

Will Install 30,000-Kw Unit

El Paso Electric Co will install a 30,000-kw turbo-generator at its Rio Grande Plant in the Upper Valley. The unit, costing $4.5 million, will increase the utility's capacity from 84,500 kw to 114,500 kw. The company also plans other improvements at a cost of $2.5 million. These will include transmission lines, substations, addition to underground network, automatic control devices, and a two-way radio system for service men.

•

IBEW Workers Get Raise

Central Maine Power Co and the International Brotherhood of Electrical Workers, AFL, have agreed on a two-year contract granting workers a general wage increase of 3¢ an hour. The contract provides for a review of wages based on the cost of living after one year. Other provisions include three weeks vacation after 15 years of service and a company-supported employee hospitalization plan.

AN ARTIFICIAL KIDNEY has been presented to New York City's Bellevue Hospital by the Consolidated Edison Co. The machine, built by Allis-Chalmers Manufacturing Co at cost as a public service, serves to cleanse the blood of patients whose kidneys temporarily fail to function. Watching the presentation demonstration are Dr J. J. Wittmer, left, company vice president; Dr Robert S. Hotchkiss, professor of urology, New York University; Chairman Ralph H. Tapscott of Consolidated Edison; Winthrop Rockefeller, chairman of NYU-Bellevue Medical Center; and Dr Marcus D. Kogel, New York City's commissioner of hospitals. Consolidated Edison gave Bellevue its first practical iron lung in 1929

Nearly $2 Billion Added to Utility Plant in 1949

Almost $1.9 billion, net after retirements, was added to plant of the privately owned Class A and B electric utilities last year. Net additions to plant accounts since 1945 total more than $5 billion the Federal Power Commission reports in its 1949 edition of "Statistics of Electric Utilities in the United States."

Operating revenues rose to more than $5 billion in 1949, only two years after they had passed the $4-billion mark. The 1949 aggregate operating revenues of $5,068,689,000 were 4.9% over the $4,830,154,000 reported for 1948. Net income for the period amounted to $757,259,000, a 15.3% increase over the year before.

Total assets of the companies at the end of last year were $19,001,350,000. This compared to $17,346,923,000 a year earlier and to $14,568,823,000 at the end of 1945.

Outstanding securities increased by a little more than $1.5 billion during 1949. Long-term debt at the end of the year amounted to $8,572,086,000, compared to $7,718,669,000 at the end of 1948. Equity securities outstanding went from $6,590,083,000 at the end of 1948 to $7,255,671,000 at the end of 1949.

SOMETHING NEW has been added to ground connection projecting through the floor of the power plant at Grand Coulee Dam. It was decorated with paper leaves and flowers after visitors asked questions about it. Employee manning a watering can completes the illusion for the benefit of a Bonneville Power Administration photographer

2 S. American Countries Order Power Units in U. S.

Sao Paulo Tramway, Light, & Power Co, Brazil, will install a 13,500-kw unit, which will serve both as a generator and a motor, in its Pedreiras power station. The unit, ordered in the United States, will generator electricity during periods of ample water supply. In dry periods it will be used to drive pumps which raise water into the Pedras reservoir.

Another South American country, Chile, has ordered two 31,000-kva turbine generators from a United States firm. The units, scheduled for delivery late in 1951, will be installed in the government's Los Cipreses hydro project. Los Cipreses will be tied in with a 154-kv power network serving central Chile. It is located on the Maule River 200 miles south of Santiago in the Andes.

•

Puget Sound P&L Gets OK for Interconnections

Puget Sound Power & Light Co has been authorized by the Federal Power Commission to maintain additional interconnections for emergency use only. The permission was granted to alleviate the power shortage now existing on Puget Sound's transmission system.

Interconnections were approved between Bonneville Power Administration's 110-kv Snohomish-Beverly No. 2 line and Puget Sound's Beverly Park substation, and between the 66-kv line of Clallam County Public Utility District No. 1 and Puget Sound's Bremerton Junction substation.

The utility's request for blanket approval of any future additional interconnections was denied by FPC.

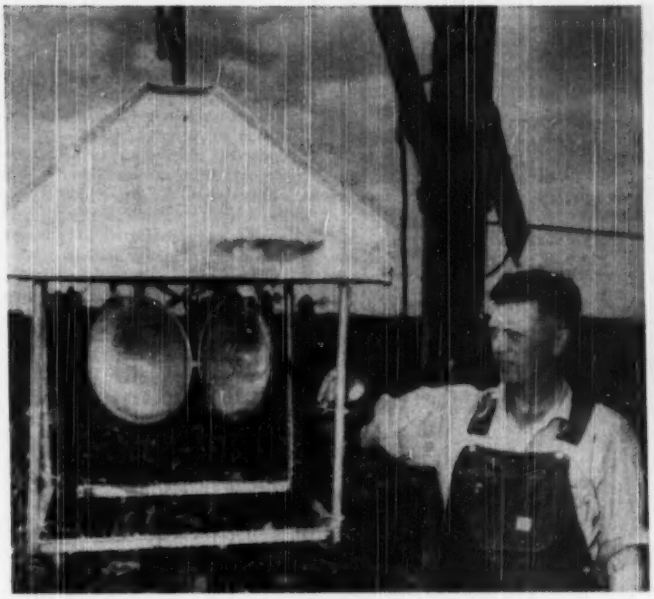
•

June Operating Revenues Almost 10% over Last Year

Electric operating revenues of Class A and B privately owned electric utilities in the United States for June were 9.8% above June, 1949, according to the Federal Power Commission.

Revenues in June, 1950 totaled $385,632,000, compared to $351,290,000 in June, 1949. Revenue deductions (including operating expenses, depreciation, and taxes) were $305,925,000, or 8.4% above June, 1949.

Gross income, including other utility operating income, amounted to $92,681,000, an increase of 13.6% for the month. Net income was up 14.4% to $68,897,000 from the $60,204,000 reported for June, 1949.



ANOTHER WAY to eliminate corn borers, so Elmer Rathjen, who farms near Austin, Minn., hopes, is this device. Theory is that lights will lure corn borer moths to their deaths on the electrical grid surrounding lights. If moths haven't laid eggs, no corn borers

Chapman Okays Contract Signed by Reclamation and Colorado Utility

FEDERAL POWER from the Bureau of Reclamation projects in Colorado will be delivered to government customers over private power company lines under a contract approved Aug 18 by Secretary of Interior Oscar L. Chapman.

The "wheeling type" contract was negotiated by bureau officials with the Public Service Co of Colorado (EW, July 3, p 63). The new Colorado agreement is similar to earlier contracts Chapman approved between the bureau and two Missouri Basin power companies—Otter Tail Power Co in North Dakota and Northwestern Public Service Co in South Dakota.

Federal hydroelectric power from Reclamation's Colorado-Big Thompson project will be delivered to the company at two existing interconnection points. Other interconnections may be constructed. Preference customers—farm co-ops and public bodies—within the company's service area will receive power from the Public Service of Colorado system.

Charge for this service by the company will be 1 mill per kwhr for customers served within 50 miles of interconnections, 2 mills per kwhr for 50-100 miles, and 3 mills for 100-150 miles. Reclamation officials said that the charge would add a mill to the kwhr rate for customers in the 50-100 mile zone and two mills in the 100-150 mile zone.

The bureau's Colorado-Big Thompson rate—an energy and demand rate of about 7.25 mills per kwhr for co-ops—includes about 1 mill as a transmission cost component. Federal customers within 50 miles of interconnection points, therefore, will get no rate hike for transmission as a result of the contract terms.

The contract also provides for use of bureau lines by the company at the same service charge schedule. At present, the company is using a bureau line between Greeley and Sterling.

Technically, the federal power which will be delivered to the company comes from the bureau's Colorado-Big "Tom" project, but it actually comes from a federal power system including two other Reclamation projects. North Platte in Nebraska and Wyoming plants in the Missouri Basin project.

Electric Farm Exhibit Feature of County Fairs

The electric farm show of the Public Service Co of Northern Illinois is a feature of seven northern Illinois County fairs this year.

The display, with "better methods" as its theme, shows how electricity saves dollars and labor for the farmer and his wife. The exhibit features electrical equipment, working models, and photographs demonstrating new ideas in crop drying, barn ventilation, food freezing, milk cooling and pasteurization, livestock water warmers, dehumidifiers, insect "killers," egg washers, egg coolers, egg graders, automatic poultry feeders, and electrically heated bee hives. A modern electric kitchen and laundry equipment display has been arranged for the farm wife.

•

Con Ed Backs Youths in Profitable Venture

One of Consolidated Edison Co's "offspring" last week paid off at the rate of 40% on its invested capital after one year of operation.

This roaring return was produced by Knickerbocker Novelty Co, maker of plastic and paper novelties. Thomas E. Timothy, 15, is president.

Con Ed joined other corporations throughout the country in sponsoring juvenile businesses. Idea is to stimulate interest in economic problems among high school groups.

The youngsters do all the work, but get advice on floating their stock issues, getting organized, and staying in production. Con Ed has seven junior enterprises under its wing. It provides supervisory adults for each from its staff. Organization on a country-wide basis is being directed by Junior Achievement, Inc, headed by Earl O. Shreve, president of the U. S. Chamber of Commerce.

•

Colleges Get BPA Grants

Bonneville Power Administration has granted a total of $30,000 to six Pacific Northwest colleges for economic and engineering studies in power utilization. The grants will permit the continuation of studies on electric space heating, sprinkler irrigation, electronic engineering devices, power management fields, and other topics. Colleges receiving the grants are Washington State College, University of Washington, Oregon State College, University of Oregon, Reed College in Portland, and the University of Portland.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
Aug. 17	2.60	2.61	2.73	3.80	4.06	4.37	5.77	6.57	7.36
Aug. 10	2.60	2.61	2.73	3.80	4.03	4.38	5.75	6.64	7.46
END OF QTR.									
2nd 1950	2.68	2.66	2.74	3.79	4.03	4.38	5.38	6.51	7.50
1st 1950	2.59	2.61	2.74	3.78	4.01	4.36	5.22	5.85	6.67
4th 1949	2.59	2.61	2.72	3.85	4.06	4.46	5.37	6.15	7.01
3rd 1949	2.61	2.65	2.77	3.88	4.15	4.54	5.55	4.67	7.51

Data: Reis & Chandler, Inc.

Industry Report Outlines 'Equitable' Excess Profits Tax from Utility View

AN "EQUITABLE EXCESS PROFITS TAX" should make allowances for "peculiar regulatory and economic conditions" under which the electric utility industry operates.

This is the thesis of a 33-page report drawn up for the industry's guidance by an informal group of utility men. The paper, titled "The Impact of an Excess Profits Tax on the Regulated Electric and Gas Utility Industry," is being made available through the Edison Electric Institute and the National Association of Electric Companies.

The report asks special consideration for utilities, not exemption from any future excess profits tax. It emphasizes that "it is not the purpose or the intent of the regulated electric utility industry to seek exemption from war profits taxes." If an electric utility earns any excesive profits arising from the preparation from war, it should be taxed like any other corporation.

A new excess profits tax should be based on a formula closer to that used by regulatory authorities in deciding on a fair return, the report says. Credit should be given for 100% of borrowed capital, as is done by the commissions, in establishing an invested capital base.

Normal tax and surtax should be deductible from that part of income subject to the excess profits tax since "in the regulated electric utility industry income taxes are deemed to be an expense of the business." Under an average earnings base the base period should be the four years beginning Jan 1, 1946, and 100% of the average earnings for that period should be allowed, the paper recommends.

Failure to take the utility industry's special problems into account will hit four ways, the report points out. Stockholders, customers, war production, and federal revenue may suffer.

An excess profits tax like the last one would impair earning power of the utilities and make it more difficult for them to sell stocks to finance construction. This might mean heavy enough debt financing to unbalance capital ratios and injure stockholders. Or it might mean higher yields on equity, ultimately to be paid by the consumer in the form of higher rates.

Utilities might even find themselves unable to finance the present $9-billion 1950–53 construction program. The defense effort demands high output by the privately owned utilities, which supply 80% of the nation's power requirements and more than 70% of its industrial capacity.

An unjust tax would defeat its own ends from the revenue standpoint. It probably would accelerate the trend toward tax-exempt public ownership, as it did in the last war. Regulatory commissions again might be tempted to order rate reductions in avoidance of the tax.

The slow rate of turnover of capital in the utility industry requires vast sums for fixed investments, the report warns. This makes the incidence of federal taxes on a utility four times that on an industrial enterprise.

In the last war excess profits taxes hit the utilities much harder than they hit manufacturing companies. Utility earnings were "seriously impaired," while industrial income "rose by substantial amounts." The Dow-Jones stock index for industrials hit a low of 69% of the 1939 base in the summer of 1942 while in the same period the utility index dropped to 45% of the base.

The burden will be even greater in the present emergency. An unprecedented expansion program is scheduled. The need for capital is greater, and no deduction can be expected from amortization of emergency facilities as in World War II. The industry's refinancing program is substantially over, eliminating deductions for such items as unamortized debt discount and expense and call premiums which helped relieve the drain on earnings before.

Under the method of computing excess profits taxes used in World War II a utility could be liable for excess profits even though its earnings were below the level considered adequate by the regulatory commisions. One large utility earned only 4.67% on its rate base before becoming subject to excess profits taxes, while another got 6.12%.

Actually, the report claims, it is impossible for electric utilities to have excess profits in the true sense of the term. Rates are set by regulatory commisions to yield a fair return covering interest, dividends, and a reasonable addition to surplus. By and large, rates are high enough to produce "sufficient earnings to attract capital needed for expansion purposes and no more," the report says.

FINANCIAL BRIEFS

Clarksville, Mo., Light & Water Co has asked the Missouri Public Service Commission for permission to sell all its property to the town of Clarksville for $1. The transfer also would include $4,500 in surplus funds to be used for maintenance and repairs. The company was organized as a civic enterprise, with its customers as stockholders. Now it needs to expand to meet higher demand for water service.

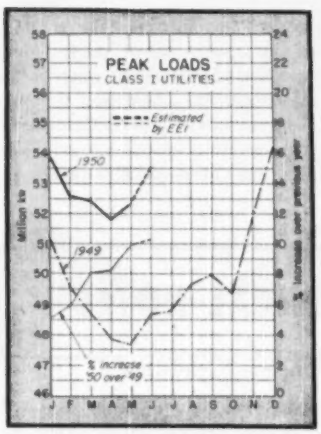
South Carolina Electric & Gas Co doesn't have to pay a South Carolina tax on bonds issued and payable in New York, the South Carolina Supreme Court has ruled. The state tax commission had contended the company should pay the state documentary stamp tax for bonds issued after the utility firm entered into a corporate mortgage with New York banks as trustees. "Tax statutes cannot be extended by implication . . . and any substantial doubt must be resolved against the government and in favor of the taxpayer," the opinion said.

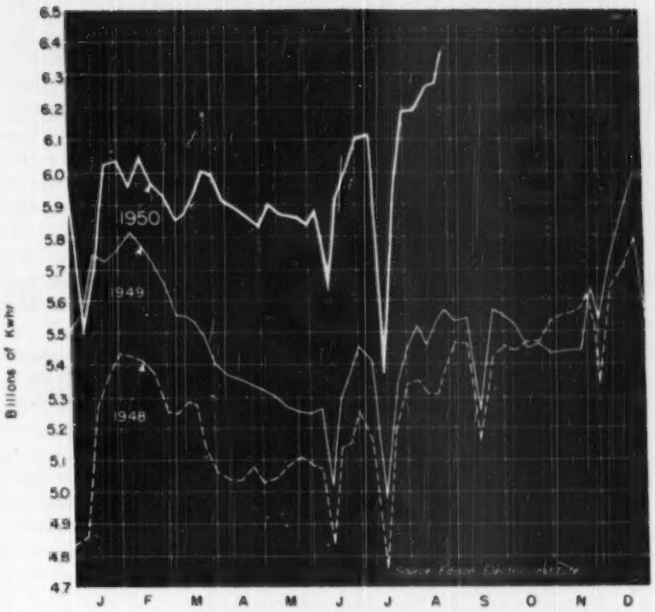
American & Foreign Power Co, holding company subsidiary of Electric Bond & Share Co, has been granted an extension to May 2, 1951, within which to comply with a Securities and Exchange Commission order directing its recapitalization. Foreign Power is now formulating a reorganization plan.

Canadian Output Statistics

The following statistics of production of electric energy by Canadian central stations, supplied by the Dominion Bureau of Statistics, are in thousands of kilowatt hours:

Period	1950	1949
Six Months' Output	24,903,925	23,462,350
Primary	22,091,164	21,396,649
Secondary	1,912,761	2,065,701
Primary Consumption	22,132,939	20,786,990
Net Exports to U. S.	1,012,538	903,291
June	4,305,111	4,028,965
Primary	3,823,984	3,598,245
Secondary	481,127	429,820
Primary Consumption	3,690,458	3,481,039
Net Exports to U. S.	167,530	154,607
May	4,417,009	4,271,827
Primary	3,933,342	3,711,627
Secondary	483,747	559,400
Primary Consumption	3,795,470	3,587,721
Net Exports to U. S.	199,275	184,060





Output Week Ended Aug 19—6,369,830,000 Kwhr

Weekly Output, Millions Kwhr

1950	1949	1948
Aug 19 6,370	Aug 20 5,579	Aug 21 5,391
Aug 12 6,253	Aug 13 5,530	Aug 14 5,318
Aug 5 6,247	Aug 6 5,466	Aug 7 5,319
July 29 6,190	July 30 5,518	July 31 5,352
July 22 6,186	July 23 5,462	July 24 5,342
July 15 6,006	July 16 5,342	July 17 5,197
July 8 5,380	July 9 4,982	July 10 4,760
July 1 6,115	July 2 5,410	July 3 5,166
June 24 6,102	June 25 5,466	June 26 5,257
June 17 6,012	June 18 5,373	June 19 5,159

Percent Change from Previous Year

	Aug 19	Aug 12	Aug 5
New England	+16.2	+13.2	+13.8
Mid-Atlantic	+14.3	+10.1	+13.5
Central Industrial	+17.4	+15.4	+19.1
West Central	+ 9.9	+ 9.2	+12.3
Southeast	+14.9	+15.0	+14.4
South Central	+16.0	+21.7	+16.7
Rocky Mountain	+12.1	+13.1	+12.5
Pacific Coast	+ 9.2	+ 8.9	+ 8.5
Total United States	+14.2	+13.1	+14.3

MEETINGS

International Association of Electrical Inspectors
Northwestern Section, New Washington Hotel, Seattle, Wash., September 10-13.

★**Edison Electric Institute**
Accident Prevention Committee, Hotel Cleveland, Cleveland, Ohio, September 11-12; Prime Movers Committee, Copley Plaza Hotel, Boston, October 2-3; Electric Equipment Committee, Chamberlin Hotel, Old Point Comfort, Va., October 9-10; Transmission and Distribution Committee, Hotel New Yorker, New York, October 19-20; Meter and Service Committee, Robert Treat Hotel, Newark, N. J., October 25-27; Industrial Relations Committee, Netherlands Plaza Hotel, Cincinnati, Ohio, November 13-16.

Northwest Public Power Association
Convention, Portland Hotel, Portland, Ore., September 13-15.

Electrical Companies Public Information Program
Workshop Conference, Stevens Hotel, Chicago, September 14-15.

Conference and Exhibit
Sponsored by Instruments and Regulators Division of American Society of Mechanical Engineers and Instrument Society of America, Municipal Auditorium, Buffalo, N. Y., September 18-22.

Pennsylvania Electric Association
Annual Meeting, William Penn Hotel, Pittsburgh, Pa., September 19-20; Transmission and Distribution Committee, Iram Temple Country Club, Dallas, Pa., October 5-6.

American Society of Mechanical Engineers
Fall meeting, Hotel Sheraton, Worcester, Mass., September 19-21.

Public Utilities Association of the Virginias
Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., September 22-23.

National Electronics Conference
Edgewater Beach Hotel, Chicago, Ill., September 25-27.

Canadian Electrical Manufacturers Association
Annual Meeting, General Brock Hotel, Niagara Falls, Ontario, Can., September 27-29.

Association of Edison Illuminating Companies
Annual Meeting, Broadmoor Hotel, Colorado Springs, Colo., September 27-30.

Southeastern Electric Exchange
Engineering and Operations Conference, Henry Grady Hotel, Atlanta, Ga., September 28-29; Sales Conference, Biltmore Hotel, Atlanta, Ga., October 25-27.

National Television and Electrical Living Show
Chicago Coliseum, Chicago, September 29-October 8.

American Institute of Electrical Engineers
Middle Eastern District Meeting, Lord Baltimore Hotel, Baltimore, Md., October 3-5; Fall General Meeting, Skirvin Hotel, Oklahoma City, Okla., October 23-27.

Rocky Mountain Electrical League
Annual Convention, Broadmoor Hotel, Colorado Springs, Colo., October 8-11.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., October 11-13.

Iowa Utilities Association
Management Conference, Fort Des Moines Hotel, Des Moines, Iowa, October 16-17.

International Association of Electrical Leagues
Annual Conference, Copley Plaza Hotel, Boston, Mass., October 11-14.

National Electrical Contractors Association
Annual Convention, Hotel Biltmore, Los Angeles, Calif., October 17-20.

National Farm Electrification Conference
Melbourne Hotel, St. Louis, Mo., October 18-20.

Wisconsin Utilities Association
Electric and Gas Section, Schroeder Hotel, Milwaukee, Wis., November 8-10.

National Electrical Manufacturers Association
Chalfonte-Haddon Hall, Atlantic City, N. J., November 13-16.

New Jersey Utilities Association
Annual Meeting, Seaview Country Club, Absecon, N. J., November 17-18.

★ Addition this week.

To Install 100,000 Hp Unit

Carolina Power & Light Co will install a third unit, with a capacity of 100,000 hp, at its Lumberton plant. It is expected to be in production by the end of 1952.

WASHINGTON COMMENT

RONALD D. ROSS

THE ELECTRIC UTILITY industry is hiding its light under a bushel these days when it comes to telling an uncertain Washington about our power preparedness.

There have been facts—backed by impressive statistics—in the statements of industry leaders. But these industry expressions have tended to be passive reassurances that there is plenty of power. The industry itself is not passive. Since the Korean crisis broke, advance construction schedules have been firmed and new orders placed. More than that, the industry has consistently demonstrated its ability to cope with emergencies.

These are the things that mobilization planners must be told today. The only certainty in Washington is uncertainty. No one is sure how much of what will be required by the present first round of mobilization. And more demands are coming in the weeks and months ahead.

Still unable to lay out mobilization needs in anything so specific as kwhr, federal officials already are looking at new power challenges.

Aluminum production, a familiar but imposing electric energy eater, will be expanded.

Government-surplus equipment capable of producing 200 million lb of aluminum per year has been sold with the understanding that it will be reactivated within 12 months. That adds up to an unpredicted new demand of roughly 200,000 kw of firm capacity. Again, this could be only a small beginning if we are to supply planes for fronts around the world.

The Atomic Energy Commission is looking for a site on which to locate a hydrogen bomb factory. Information on how much power will be needed and when is secret, of course, but it may be assumed that the requirements will be large. This and any stepped-up wartime power needs at existing atomic production centers could put a serious crimp in today's forecasts of future power demands.

New capacity needs, beyond and apart from even the most farsighted of present construction schedules, will come from mobilization. Federal power men know this and are counting on it. When defense demands bring unforeseen power problems, they'll scream "power shortage!" and rush in with their plans. Of course, it will be argued, we have to have a CVA to get this job done, and that job means an okay on a pretty controversial project.

The time for industry to begin refuting this sort of argument is now. Thinking and policy are being shaped in Washington, even in the present confusion.

The industry's answer to this should not be the defensive argument that there's no power shortage today except in the two areas most dependent on federal power. Neither need it be simply past and present glory—in impressive statistics of growth and future plans. It's something more.

An industry statement attuned to Washington today might carry this message: Four of every five kw of America's generating capacity—the greatest in the world—are investor owned. We, the private electric utility industry, are successfully meeting the demands of unprecedented postwar load growth. Now, we are prepared to face the new challenges of defense mobilization. If more power is needed for defense, tell us where.

This sort of statement squares up to the fact that we are facing the unknown when we attempt to calculate the power requirements of another war. It admits to real uncertainties but accepts the challenge.

Too, it's not a complacent approach to problems that defy complacency. It reflects the dynamic quality of an industry which has demonstrated that it is both farsighted and alert.

Present power—on the line and under construction—is only part of the emergency power story. More important than the question of shortage or plenty is the proven ability of the industry to adapt itself to emergency demands. This is not only the answer the industry needs to give national defense planners, but it is also the answer the industry must be prepared to justify.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Chromium plating process promises to be improved now that radio-active isotopes indicate that the chromium is deposited out of the bath in the hexavalent state rather than the trivalent previously assumed.

Radioactive isotope shipments by AEC have grown to 3,000; 50 companies are using them industrially and 50 others are making detection and measurement equipment.

Friction phenomena and amelioration are susceptible of exploration by resort to radioactive tracer isotopes.

Safety engineers would do well to study the obscure hazards of nuclear reactors against the day when the utilities engage in pilot plant experiments.

Welding fumes under normal welding conditions are not a cause of pneumonia or silicosis and do not create a tendency to tuberculosis or stomach ulcers.

Preferred ratings of turbogenerators are commanding a high fraction of purchases because they carry more capacity margins; eg a 60-Mw with 10% margin (66 Mw) costs no more than a conventional 50-Mw with 25% margin (62.5 Mw).

Replacement Cost Behavior

A rational approach to the economics involved in replacing obsolete utility plant and equipment. A specific procedure is applied

PAUL H. JEYNES, Distribution Plant Engineer
Public Service Electric & Gas Co, Newark, N. J.

THIS DISCUSSION undertakes to outline a rational approach to economic problems involving utility plant replacement, and to explain in engineer's language why it is correct. It also describes in detail the arithmetic involved, which is quite simple though rather lengthy. In addition, it clears up two or three common errors in reasoning which appear repeatedly in writings on this subject.

Treatises on this subject which appeared in the technical press exhibit one characteristic in common—engineers do not handle the cost behavior of their equipment with the same assurance they have as to its mechanical or electrical behavior.

General Approach . . . Consider an old piece of equipment which is not as good as new, but still serviceable. Do the advantages of new equipment—greater efficiency, lower maintenance costs, or what not—justify its immediate replacement?

First it is necessary to estimate the remaining life of the old unit if it is not replaced immediately. Then, for the duration of that life expectancy, we compare costs to the consumer: (a) If the existing equipment is retired and replaced immediately; and (b) if it is kept in service.

After this period of comparison, annual costs are presumably the same in either event (= annual costs of the new equipment). The cheapest plan, or "economic choice", is the one for which the present worth of the comparative annual costs is the least.

In making the comparison, it is not necessary to include all the costs of doing business, but only those items which would be affected by the final decision to replace or not. The items of annual expense ordinarily affected by such a decision are: (1) Return; (2) taxes; (3) depreciation; (4) operation and maintenance.

Annual Costs of New Plant . . . If the old equipment is replaced immediately, annual costs on the new replacement start at once. They are conveniently estimated as a level annual percentage of the first cost, installed, of

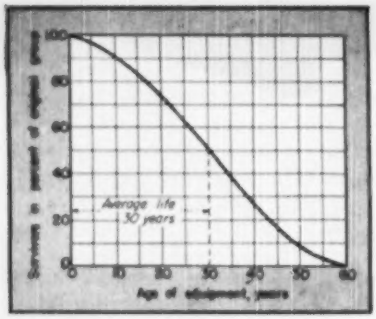


FIG 1—TYPICAL SURVIVOR CURVE (Iowa type S-). Some units have longer lives, some shorter, than the average. The effect of this "dispersion of retirements" on costs must be recognized

the new equipment. Derivation of appropriate percentages will be discussed later.

It is impossible to predict the life of any individual plant unit, but we can estimate with considerable assurance, what the *average* expectation is for a group of units. Each individual plant unit must be treated as behaving in this average manner. Suppose retirements can be anticipated per the survivor curve of Fig 1. Within the period of cost comparison, there will be some retirements of the new equipment. The estimate of carrying charges on the new plant must provide for replacements of these early retirements, as well as for the initial installations of new plant.

However, there is no need to distinguish between new meters or their replacements, because the same average annual rate applies to both. If the first cost, installed, of the new plant unit (or its replacement, in turn, in the near future) is $13, and annual costs based on average life expectancy are 11.15%, then annual costs would be $1.45 per year throughout the period of comparison, and would continue at that rate.

Annual Costs if Not Replaced . . . If the old plant is not immediately replaced, but is left to serve out its normally-expected remaining life, we again find it impossible to predict the remaining life of any individual unit. However, *average* expectancy can be estimated, and each individual old meter must be treated as conforming to that average behavior.

Thus, if old meters are not immediately replaced, the number of old meters can be expected to decrease gradually, as indicated in Fig 2A (showing retirements after age 25 if average life is 30 years, Iowa Type S, survivor curve). Remaining life after age 25 is 15 years on the average, but this does not mean that each meter will last exactly 15 years longer. On the contrary, each meter can be regarded as conforming to the average expectancy, Fig 2B, the shaded portion of Fig 2A replotted, taking the number of survivors at age 25 as 100%.

Thus, for each old meter not replaced immediately we must consider two categories of future costs:

(a) Annual costs of the gradually decreasing number of old meters, plus

(b) Annual costs of the gradually increasing number of new meters required as replacements.

Here it is essential to distinguish between old meters and their replacement, because the two have different annual costs. Virtually all writers on the subject ignore this fact and assume that if the old meter is not replaced, annual costs per meter will continue throughout its average remaining life at the level percent of first cost. Although latter assumption is a tremendous short cut, it is often a very rough approximation indeed of the actual situation. It amounts to assuming that the shaded portion of Fig 2A may be represented by Fig 3, rather than Fig 2B. Almost any assumption—even an outright guess as to the survivor curve applicable—would be better.

Annual Cost Percentages . . . Engineers are prone to regard estimates of annual costs in percent of investment as outside their province, to be dictated by management or the accounting department. Perhaps it is this attitude that encourages misuse or misinterpretation of cost data, which prompts the following discussion.

Rate of Return . . . The principal effect of a decision to replace old plant is usually the increased return necessary, in dollars. The annual cost of money is often carelessly referred to as "interest", but it is important to remember that in its narrow sense interest means the annual return on bonds only, which is not subject to federal income tax. Annual return is substantially interest on bonds* plus dividends on preferred stock and earnings on common stock equity.

* The total cost of money, of course, includes other items such as charges to amortization of debt discount and expense, etc.

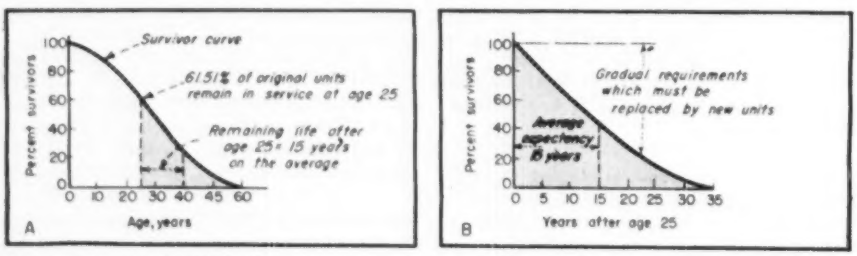


FIG 2—LIFE EXPECTANCY (A) of old equipment. Survivor curve (B) for units serving past age 25. Shaded portion of (A) is here replotted in percent of survivors at age 25. Calculations are in Table I

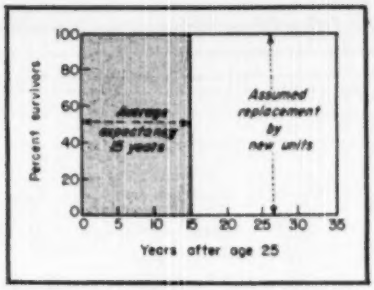


FIG 3—A COMMON rough approximation of life expectancy. By assuming that all existing units would serve exactly the average expectancy, a shortcut in the computation may be obtained at the expense of accuracy. The shortcut amounts to assuming that this graph is the equivalent of Fig 2B. Shaded portions have identical areas, but the difference in dispersion of retirements affects costs

Annual return can ordinarily be estimated as a constant percentage of first cost, say 6% or thereabouts.

Income Taxes . . . Whether the statutory rate will remain at the present level (38% of taxable income) is a matter for judgment; but to express annual income taxes as a percent of *first cost*, we must first predict the future rate as a percent of taxable income, and then do a little simple arithmetic, as follows.*

Suppose we have estimated the rate of return at 6%. It is further necessary to anticipate the relation between debt (bonds) and equity capital (stock), as well as the cost of borrowed funds (interest rate on bonds).

Suppose the ratio of bonds to stock, as shown by the annual balance sheet, is 50-50, with interest at 4%. Then for each $100 of capital investment, $50 represents bonds which contribute $2 per year to return, exempt from taxes. Thus, taxable income would be:

$$\$6 - \$2 + \text{Tax}$$

Accordingly:

$$\text{Tax} = 0.38\ (\$6 - \$2 + \text{Tax})$$
$$= \$2.45 \text{ per } \$100 \text{ of capital investment.}$$

Again, a graphical presentation of the facts will help to explain the computation. Fig 4 shows annual costs in the form of a heat-flow diagram.

Total revenues, representing the summation of all affected costs, or "gross receipts", are shown coming in from the left. Annual costs, also sometimes called annual expenses or "carrying charges," are shown tapped off in turn, the first item being taxes on gross receipts, if there is such a charge. Other items of expense are tapped off further to the right; the special treatment of depreciation expense will be discussed later. Finally, income taxes are deducted, leaving the annual return (interest and dividends). The width of the band just before income taxes are subtracted, less tax-exempt interest, represents taxable income. Hence the expression for taxable income above: $6 — $2 + Tax.

For purposes of cost analysis, this diagram may be viewed in the opposite direction. That is, entering from the right with our assumed rate of return, we can immediately estimate the tax on that return, regardless of expenditures for maintenance or other costs. Accumulating the other items of cost, we finally arrive at the resultant revenue requirements. The cheaper plan is the one resulting in minimum revenue requirements.

It is often erroneously assumed that one additional dollar spent for maintenance reduces taxable income accordingly, and consequently reduces income tax by $0.38, leaving a net maintenance cost of only $0.62. Fig 4 demonstrates that this cannot be true with a fixed percent return (6%). It could be true only if *revenues* remained fixed whether the meter is replaced or not; but this is quite contrary to the facts and assumptions. Fundamentally, the utility must obtain revenues equal to expenses plus return; return is a fixed percentage whether the old meter is replaced or not; but expenses (depreciation, maintenance, taxes) differ in the two cases. Accordingly, the utility's revenue requirements differ, depending upon the decision to replace or not. The cheaper plan is the one which, for the given percent return, results in minimum revenue requirements—ie, minimum costs to the consumer—which is the economic criterion. Surely the desirable plan is not the one that

TABLE I—Life Expectancy If Existing Equipment Is Kept in Service

(Existing equipment is expected to have a 30-year average life, with retirements per Fig 1. It is now 25 years old, and an estimate of its future serviceability is desired. As retirements occur, gradual replacement by new equipment takes place.)

Col. 1	2	3	4
Age, Years	Survivors in % of Original Equipment	Survivors in % of Equipment Now in Service	New Equipment Required to Replace Gradual Retirements
25	61.51	100.00	0.00
26	59.23	96.29	3.81
27	56.93	92.55	7.45
28	54.63	88.81	11.19
29	52.32	85.06	14.96
30	50.00	81.29	18.71
31	47.68	77.52	22.48
32	45.37	73.76	26.24
33	43.07	70.02	29.98
34	40.77	66.28	33.72
35	38.49	62.54	37.46
36	36.24	58.92	41.08
37	34.00	55.28	44.72
38	31.79	51.68	48.32
39	29.62	48.15	51.85
40	27.47	44.66	55.34
41	25.37	41.25	58.75
42	23.32	37.91	62.09
43	21.31	34.64	65.36
44	19.35	31.46	68.54
45	17.45	28.37	71.63
46	15.62	25.39	74.61
47	13.85	22.52	77.48
48	12.15	19.75	80.25
49	10.53	17.12	82.88
50	8.99	14.62	85.38
51	7.55	12.27	87.73
52	6.20	10.08	89.92
53	4.95	8.05	91.95
54	3.81	6.19	93.81
55	2.79	4.54	95.46
56	1.91	3.11	96.89
57	1.16	1.89	98.11
58	0.58	0.94	99.06
59	0.17	0.28	99.72
60	0.00	0.00	100.00

Notes:

Column 2 obtained from Bulletin 156, Iowa Engineering Experiment Station, Iowa State College (plotted in Fig 2A).

Column 3 represents Column 2 figures in percent of the survivors at age 25 (=61.51%). They are plotted in Fig 2B.

Column 4 equals 100% less Column 3.

* This method was proposed by Alex E. Bauhan in his paper "Interconnection Services, Their Classification and Evaluation". AIEE *Transactions*, December 1931, p 1,247. It assumes that taxable income equals book income, an approximation adequate for the present application.

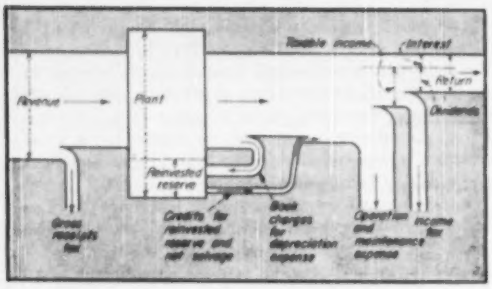


FIG 4—FLOW CHART of utility costs from revenue to return

would reduce the return to owners of the business.

Perhaps it will be obvious that the same reasoning applies to loss of revenue from under-registration of customers' meters. In order to maintain the return at the assumed rate, the dollars lost through under-registration must be made up by way of a higher charge per kilowatthour applied to the energy that is registered. Each dollar of lost revenue is properly regarded as one dollar of increased annual costs.

Taxes on Gross Receipts . . . Published articles rarely mention taxes on gross receipts as an item of cost, but some utilities find them to be an important factor. In New Jersey, for example, they amount to about 11% of gross revenue, and are increasing. An appropriate way of dealing with them is to estimate their future rate as a percentage of gross receipts before taxes; the total of annual costs other than gross receipts taxes are then to be increased by that percentage.

It is sometimes convenient to express these taxes as a percentage of first cost, as follows:

Let T = tax rate in percent of *gross receipts*
A = total annual costs other than gross receipts in percent of *first cost*
r = annual gross receipts taxes in percent of *first cost*
Then $r = T(A + r)$
Or if $T = 11\%$ of gross receipts before taxes,
$r = 0.11(A + r) = 0.124A$

Annual Cost of Depreciation . . . Fortunately, problems in replacement economics do not require any knowledge of depreciation theory; however, they do require a meticulous use of correct arithmetic. To illustrate the gross errors that may be introduced by using wrong arithmetic, consider Table II.

It is not uncommon to find annual costs of depreciation estimated by simply dividing first cost by average life (Table 2, Column 2). For example, for a 40-year life, depreciation expense would be placed at 2.50%, presumably in the mistaken belief that this represents annual costs per the straight-line method. This is approximately a 100% over-estimate of the true annual costs for a 40-year life.

Table 2, Column 3, shows another familiar error in arithmetic. Here, annual depreciation expense is estimated as the annual payment which, retained at interest, will amount to first cost within the average life of the equipment. This annuity may be computed as $i / [(1+i)^n - 1]$, where i = rate of return, and n = average life in years; or it may be found in any handbook of financial mathematics. As indicated in Table 2, the true annual costs of depreciation are about 100% more than this figure, for 40-year life.

TABLE II — Right and Wrong Estimates of Annual Depreciation Costs

(Assumed type of dispersion Iowa Type S_0, return at 6%, zero net salvage.)

For the purpose of economic comparisons, the cost of depreciation is to be expressed as a level percentage of first cost in each year. This figure, shown in Column 4, is independent of the company's method of accounting for depreciation. Columns 2 and 3 are estimates often proposed for this application; actually, they represent incorrect arithmetic.

Col. 1	2	3	4
Average Life, Years	Reciprocal of Average Life, %	Annuity to Recover Original Cost in Average Life, %, Not Adjusted for Dispersion of Retirements	Present Worth Method, %, Group Basis (See Table 3)
20	5.00	2.72	3.40
25	4.00	1.82	2.48
30	3.33	1.26	1.90
35	2.86	0.90	1.51
40	2.50	0.65	1.23
45	2.22	0.47	1.02
50	2.00	0.34	0.86

Notes:

Column 2. The reciprocal of average life represents the net cost of depreciation, straight-line method, in the first year of life only. In every subsequent year the net cost, straight-line method, decreases; it is not a level annual percentage.

Column 3. The annuity may be read from standard 6% tables ("the annuity which will amount to one dollar in a given time"), or may be computed as $i / [(1 + i)^n - 1]$, where i = rate of return, and n = life in years. But it makes no allowance for dispersion of retirements, and will not fully recover original cost.

Column 4. The annuity computed per Table 3 is the constant percentage of first cost in every year which is exactly sufficient to recover original cost.

The correct estimates for the assumed conditions appear in Column 4. It will be seen that the conditions include:

(a) Average life.

(b) Type of dispersion (ie, the manner in which retirements are scattered about average life).

(c) The rate of return.

(d) Net salvage value.

First, the arithmetic involved in computing the correct rate for any other condition will be described; then, briefly, the reasons why this is the "correct" estimate.

Present Worth Group-Method Computations . . . In estimating average life, it must be appreciated that not all retirements occur at the same age; some units are retired at an early age, while some serve long past the average. When statisticians investigate average life of plant, they simultaneously investigate the manner in which individual retirements are scattered about the average—ie, its *type of dispersion*. The importance of the latter has become quite generally recognized through the efforts and publications of two groups—the Committee on Depreciation of the NARUC, and the Depreciation Accounting Committee of EEI. The Iowa Engineering Experiment Station, Iowa State College, recognizing the need for a codified system to describe various types of dispersion, has developed a family of generalized survivor curves which are widely accepted.* Bulletins describing them are available, and are the starting point of the arithmetic outlined in Table 3.

The calculations, though rather lengthy, can be performed by a high-grade clerk. They amount simply to a determination of the present worth of future service-

* Bulletins 125, 155, and 156. The family of curves developed by Professor Winfrey are commonly referred to as the "Iowa Type Curves". Other generalized curves are available, but less widely used.

TABLE III—Computation of Annual Cost of Depreciation

6% Present Worth Method, Group Basis

20-Year Average Life; Iowa Type S, Dispersion

Col. 1	2	3	4	5	6
Year	Survivors at End of Year	Mean Survivors	Present Worth Factors	Col. 3 × Col. 4	Accumulation of Col. 5 from bottom
0	1.0000	...	1.0000	...	10.6399
1	0.9965	0.9982	0.9434	0.9417	9.6982
2	0.9884	0.9924	0.8900	0.8832	8.8150
3	0.9767	0.9826	0.8396	0.8250	7.9900
4	0.9619	0.9693	0.7921	0.7678	7.2222
etc	etc	etc	etc	etc	etc
38	0.0116	0.0174	0.1092	0.0019	0.0010
39	0.0035	0.0075	0.1031	0.0008	0.0002
40	0.0000	0.0017	0.0972	0.0002	0.0000

Notes:

Annual rate = reciprocal of Col. 6 in Year 0, minus 0.06

$$= \frac{1}{10.6399} - 0.06 = 0.034$$

This is the correct rate if net salvage is zero; if net salvage is s%, the adjusted rate is 0.034 (100 − s)/100.

Column 2. From Bulletin 156, Iowa Engineering Experiment Station, Iowa State College, for the assumed average life and dispersion type.

Column 3. Computed as the arithmetical average of successive figures in Column 2.

Column 4. From standard 6% tables in any handbook of financial mathematics.

(For a discussion of this simplified method of computation, see Appendix B of "An Appraisal of Methods for Estimating Service Lives of Utility Properties", a report of cooperating committees on depreciation of the American Gas Association and Edison Electric Institute, Feb. 14, 1942.)

years (the first figure in Column 6), from which the annual cost of depreciation is computed directly as indicated.

Why This Method is "Correct" . . . To be correct, the arithmetic must give consideration to two phenomena often overlooked:

1. The fact that not all retirements occur exactly at average life (ie, reinvestment of the reserve), and

2. The manner in which depreciation reserves are utilized (ie, reinvestment of the reserve).

Both factors are recognized in the arithmetic of Table 3. By tabulating the percent survivors in each year, allowance is made for the effect of retirements on the service-years rendered in each successive year. By computing the present worth of future service-years, allowance is made for the effect of interest on the reserve between date of purchase and the date of service rendered.

This allowance for interest is not a matter of depreciation theory. It merely acknowledges the facts, as illustrated by Fig 4, that accumulated reserves are "plowed back" into plant, thus reducing the amount of company financing necessary, and reducing costs by the amount of return on security issues thus avoided. Occasionally, lacking opportunity for reinvestment, a utility may, instead, invest reserve funds in securities, income from which contributes to gross income of the business or to the reserve itself. But in either event, the utility's net cost of depreciation is less than the bookkeeper's charges to "depreciation expenses."

Note again that this allowance for interest credits on the reserve is not theoretical. It does not assume that the company retains such earnings in the reserve. It does not assume the existence of a sinking fund, actual or hypothetical. Credits for interest earned by the reserve must be allowed, whether we use the straight-line method or any other method of depreciation accounting.

There is a third reason why the method of Table 3 is "correct"; that is, annual costs so estimated are a *level* precentage of first cost in every year. Any method which does not yield a level annual rate complicates the cost comparison, because we cannot then assume that after any particular date the alternative annual costs will be identical in both cases. It is for this reason that the straight-line method is not well adapted to economic cost comparisons. That is, straight-line depreciation does not result in level annual charges, because the credits for reinvested reserves start at zero in the first year, and increase in every successive year as the reserve grows.

When the arithmetic is correctly carried out, the final answer is the same whether straight-line, sinking-fund, or any other depreciation procedure is used. But unless

(Continued on page 139)

TABLE IV—Comparison of Annual Costs

The complete solution to the problem of economic meter replacements suggested in the text

Col. 1	2	3	4	5	6	7	8
	Annual Costs if Retained in Service						
Year	On Survivors of Old Equipment	On Gradual Replacements by New Equipment	Total Annual Costs (Col. 2 + Col. 3)	Annual Costs if Replaced Immediately	Difference in Annual Costs (Col. 5 − Col. 4)	Present Worth Factor at 6%	Present Worth of Col. 6
1	$1.09	$0.00	$1.09	$1.45 − 2.24	$0.36 − 2.24	$0.9434	$ − 1.90
2	1.05	0.06	1.11	1.45	0.34	0.8900	0.30
3	1.01	0.11	1.12	1.45	0.33	0.8396	0.28
4	0.97	0.16	1.13	1.45	0.32	0.7921	0.25
5	0.93	0.22	1.15	1.45	0.30	0.7473	0.22
6	0.89	0.27	1.16	1.45	0.29	0.7050	0.20
7	0.84	0.33	1.17	1.45	0.28	0.6651	0.19
8	0.80	0.38	1.18	1.45	0.27	0.6274	0.17
9	0.76	0.43	1.19	1.45	0.26	0.5919	0.15
10	0.72	0.49	1.21	1.45	0.24	0.5584	0.13
11	0.68	0.54	1.22	1.45	0.23	0.5268	0.12
12	0.64	0.60	1.24	1.45	0.21	0.4970	0.10
13	0.60	0.65	1.25	1.45	0.20	0.4688	0.09
14	0.56	0.70	1.26	1.45	0.19	0.4423	0.08
15	0.52	0.75	1.27	1.45	0.18	0.4173	0.08
16	0.49	0.81	1.30	1.45	0.15	0.3936	0.06
17	0.45	0.85	1.30	1.45	0.15	0.3714	0.06
18	0.41	0.90	1.31	1.45	0.14	0.3503	0.05
19	0.38	0.95	1.33	1.45	0.12	0.3305	0.04
20	0.34	0.99	1.33	1.45	0.12	0.3118	0.04
21	0.31	1.04	1.35	1.45	0.10	0.2942	0.03
22	0.28	1.08	1.36	1.45	0.09	0.2775	0.02
23	0.25	1.12	1.37	1.45	0.08	0.2618	0.02
24	0.22	1.16	1.38	1.45	0.07	0.2470	0.02
25	0.19	1.20	1.39	1.45	0.06	0.2330	0.01
26	0.16	1.24	1.40	1.45	0.05	0.2198	0.01
27	0.13	1.27	1.40	1.45	0.05	0.2074	0.01
28	0.11	1.30	1.41	1.45	0.04	0.1956	0.01
29	0.09	1.33	1.42	1.45	0.03	0.1846	0.01
30	0.07	1.36	1.43	1.45	0.02	0.1741	0.00
31	0.05	1.38	1.43	1.45	0.02	0.1643	0.00
32	0.03	1.40	1.43	1.45	0.02	0.1550	0.00
33	0.02	1.42	1.44	1.45	0.01	0.1462	0.00
34	0.01	1.44	1.45	1.45	0.00	0.1379	0.00
35	0.00	1.45	1.45	1.45	0.00	0.1301	0.00
36	0.00	1.45	1.45	1.45	0.00	0.1227	0.00
					Saving by retaining old meter		$0.85

Notes:

Column 2. Number of survivors per Table 1, Column 3, multiplied by $1.09 per year (= annual costs of an old meter, per text)

Column 3. Number of gradual replacements, per Table 1, Column 4, multiplied by $1.45 per year (= annual costs of a new meter, per text)

Column 5. Annual costs of a new meter, per text = $1.45 per year. In first year, an immediate credit of $2.24 for salvage of old meter, including offset on taxes.

Column 7. Present worth factor at 6%, from any handbook of financial mathematics.

Column 8. In Year 1, present worth = 0.9434 × 0.36 − 2.24 = $ − 1.90. That is, the annual cost, effective as of the end of year, is discounted to its present worth, but the salvage value, being obtained immediately, is not discounted.

Water Heater Standards Require Study

TEN CONCLUSIONS have been reached by the Edison Electric Institute electric water heating committee from a survey of electric water heating equipment and practices. Purpose of the survey was to compare conditions as of Jan. 1, 1950, with those of Jan. 1, 1948.

Questionnaires returned totaled 102 as compared to 103 received in 1948, which illustrates the continuing high interest in this subject. The 1950 survey shows 20,044,351 residential and farm customers being served by reporting companies, with an over-all water heater saturation of 7.4%, as compared to 17,553,837 customers with a 7.0% saturation two years ago. Again, practically all reporting companies had gas competition (96.0%). Eighty-nine companies, 87.0% of those reporting, are actively promoting water heating, while in 1948 questionnaires showed that 8.3% were so engaged.

Regarding standardization, some progress has been made in the use of NEMA standard wattages, voltages, thermostat settings and ratios of wattage to tank capacity. Eighty-eight companies report using standard wattages, a gain of 3; 96 use standard voltages, a gain of 4; 84 use standard thermostat settings and differentials, a gain of 2; and 63 use standard ratios of wattage to tank capacity, a gain of only one. In these details it must be emphasized that progress towards standardization is not too encouraging. However, companies not following NEMA standards showed only minor differences.

Ninety-four respondents again stated that electric water heaters being furnished by manufacturers were acceptable as to openings, tank sizes, shapes, pipe connections, heat traps, etc. As in 1948, this represents 92% of respondents.

As in 1948 the important area of difference embraces control. Of the 102 companies this year, 35 reported uncontrolled service and 66 controlled. One did not state its policy. The 1948 survey of 103 companies showed 42 offering uncontrolled service and 60 controlled service. One offered both types. Comparing the two surveys might indicate a tendency towards controlled service, as about the same companies reported both years. Referring to the number of hours in the control period, the latest survey shows 19 different variations with no more than 10 companies using one period. Results are about the same as obtained in 1948, when 17 different variations were recorded with only 9 companies using a given period. Periods reported in 1950 varied from 3 to 20 hr, with 35 controlled periods of 10 hr or less and 15 of more than 10 hr. There seems to be no trend toward changing the length of the controlled period as the 1948 survey shows about the same results.

It is again emphasized that as a result of this wide variation in control practices and miscellaneous local considerations, conformity to NEMA standard ratios of wattage to tank capacity is not in line with conformity to other NEMA standards.

An important area of difference is the service wiring of heaters. Thirty-two companies specify two-wire circuits, 15 state both units must be supplied by three-wire circuits, 3 use both methods, one states it is optional, and 10 did not state company policy. Again we find no tendency towards standardization and definitely no improvement over 1948.

As reported two years ago, water heating is still to a large extent tailor-made to local conditions, specifically in reference to control methods and charging hours. Notwithstanding wide variations in operating characteristics, some progress has been made in adoption of NEMA standard wattages, voltages and thermostat settings. Concerning progress toward standardization in wiring and in ratios of wattage to tank capacity, little or no gains are apparent. However, it is fairly well established that very little can be done due to wide variations in basic operating characteristics of the companies.

It is appropriate to mention here that an American Standard for Household Automatic Electric Storage Type Water Heaters has recently been approved under the procedure of the American Standards Association. Copies of the American Standard are available from either American Standards Association, Inc, 70 E. 45th Street, New York 17, or NEMA, 155 E. 44th Street, New York 17.

The Edison Electric Institute Water Heating Committee concludes:

1. A joint NEMA-EEI committee should make a still further study of higher ratios of wattage to tank capacity with a view to bringing more companies within the standardization program.

2. Wattage standards require further study. Indications are that several sizes of units could well be eliminated resulting in further standardization.

3. There should be a study of installation problems, wiring of heaters, metering methods and methods of time control with the object of lowering installation costs.

4. Pressure and temperature protective devices and methods of application should be studied and standardized. The EEI water heating committee should consult with other EEI committees and the NEMA committee who are studying this same subject.

5. There is still a need for improved dealer and customer educational material.

6. An industry study and review of the economics of water heating should be undertaken with special emphasis on rates, methods of control, and charging hours.

7. All utilities should review their water heating policies to ascertain if standard heaters can be used.

8. Tank corrosion problems should receive further study.

9. Nationally every effort should be made to encourage plumber interest in the sale of electric water heaters.

10. There is an ever-increasing need for larger size heaters.

Rollers Speed Installation of Cables Over Gorge Wall

Eighteen 12-kv, steel-wire-armor generator cables were installed in 275-ft vertical runs at the rate of one per day

C. T. NICHOLSON, Engineering Dept
Niagara-Mohawk Power Corp, Buffalo

TEMPORARY WOODEN structures, rollers and special steel supports permitted 18 lengths of 12-kv generator cable to be installed one per day in Schoellkopf Station on the Niagara River. Rollers enabled cable to be pulled in vertical runs of 275 ft without splices, all from one reel setup in the switchhouse above the gorge. Potheads were eliminated at cable terminals by the use of compound-insulated cables.

This new cable capacity was needed to handle increased generating capacity in the hydro station. New cables also replaced part of the original cable runs. Locating and supporting the new cable runs was a primary consideration. Several large penstocks, 9 ft in diam and located on 25-ft centers, carry water over the gorge wall to the turbines. These penstocks are enclosed by a false front of masonry. Original lead-covered generator cables are installed in formed concrete slots on the gorge wall between penstocks. The problem of supporting new cable runs was solved by steel beams placed in front of old cables and between penstocks.

New cables are 3-conductor, 350-Mcm copper, steel-wire-armored cable, 4 in. in diameter and weighing about 15 lb/ft. Each conductor is insulated with a 21/64-in. wall of ozone-resistant compound, with a 5-mil metal shielding tape over the insulation. White wax impregnated jute bedding is applied over the 3-conductor core assembly and 53 galvanized armor wires placed overall.

This type of cable was chosen because (1) Any type of lead-covered cable would have required pulling-in from the bottom of the run to forestall the possibility of the lead sheath failing due to the tension produced by its own weight; (2) oil impregnated, paper insulated cable in a vertical run would produce a tendency for impregnant migration and would introduce the problem of sheath damage from hydrostatic oil pressure.

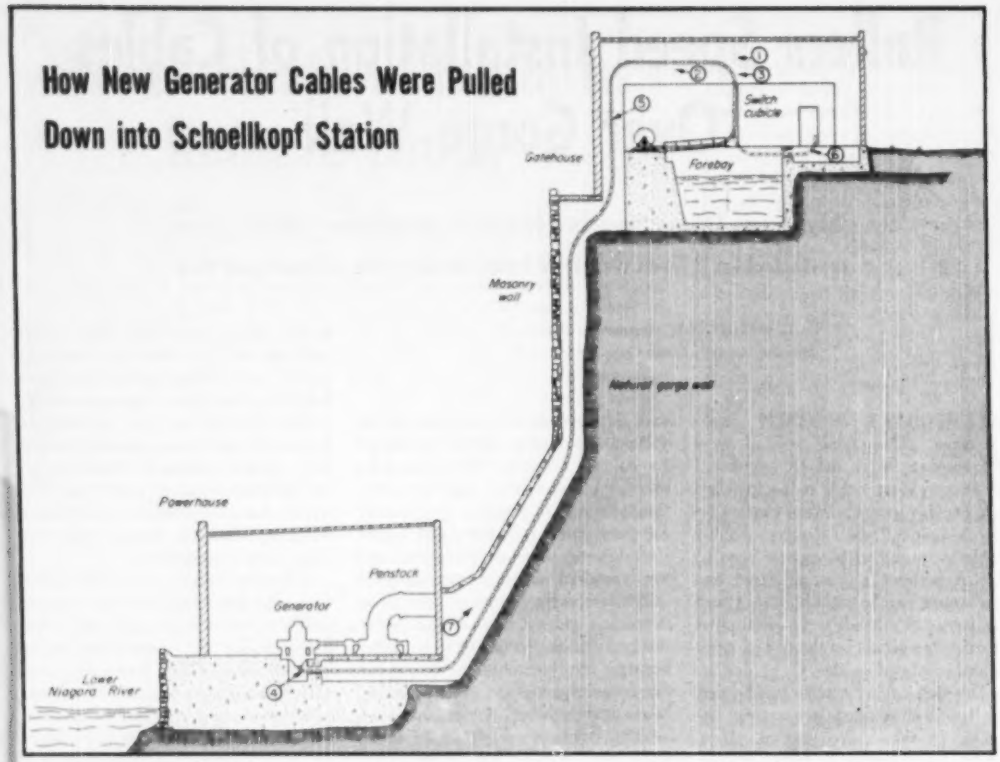
Illustrated on the next page is a simplified cross-section of the hydro station, showing route of new cables between the gatehouse at the top of the gorge and turbine and generator house at river level. A reel stand and braking device were set up adjacent to the forebay in the gatehouse. Cable was fed directly from the reel and guided over rollers along the gatehouse roof and down the gorge wall. Rollers attached to part of the permanent cable clamp permitted cable to be pulled almost in final clamping position. After each run the rollers were removed, the cable was dropped into the clamps and the clamps were assembled.

A hoisting engine pulled the cable along the gatehouse roof to a point where the weight of cable over the gorge pulled the remaining cable from the reel. Cable was restrained against gravity by the reel brake. A cable grip served as a safety precaution against failure of the reel brake.

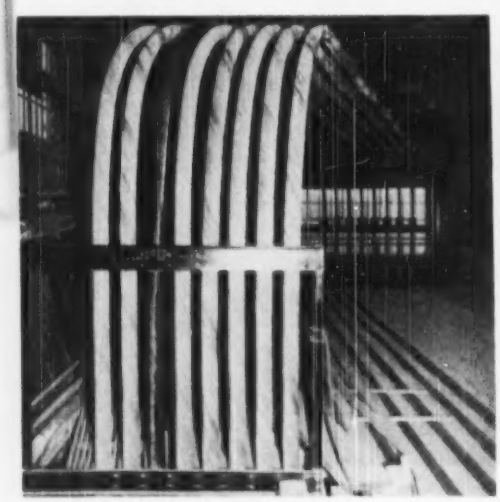
MASONRY WALL encloses penstocks and original cable runs to preserve the natural beauty of the Niagara River gorge. Hydro station is a few thousand feet below the falls

For pictures of how the job was done please turn the page ➡

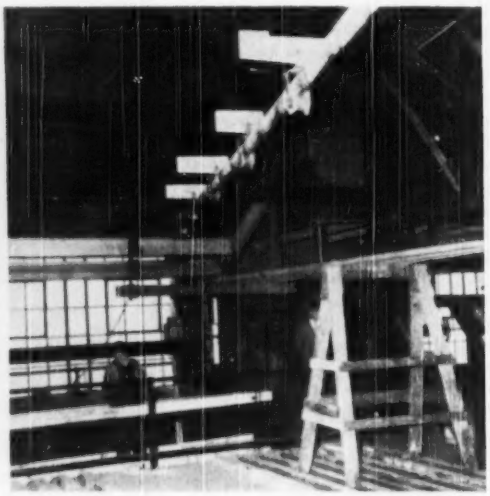
How New Generator Cables Were Pulled Down into Schoellkopf Station



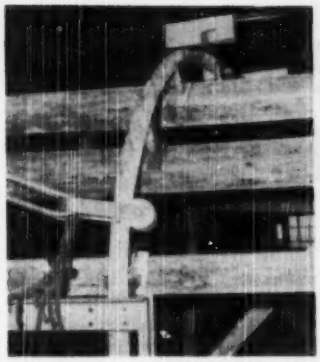
CABLE ROUTE 600 ft long is indicated by dashed line. Circled numbers show where accompanying photographs were taken. Eighteen cables were installed from a single reel setup in gatehouse. Rollers on temporary foundations guided cable around major bends



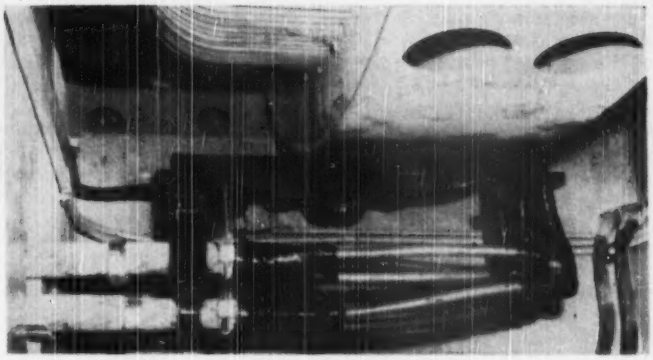
1 COMPLETED ARRANGEMENT of eight steel-wire armored 12-kv cable across gatehouse roof trusses. Ten other cables of the same type were similarly installed in another location



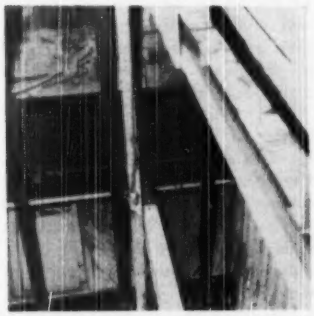
2 SPECIAL STEEL BEAMS were erected to support cables from trusses of gatehouse roof. Steelwork and beams between penstocks accounted for most of the two-month installation time



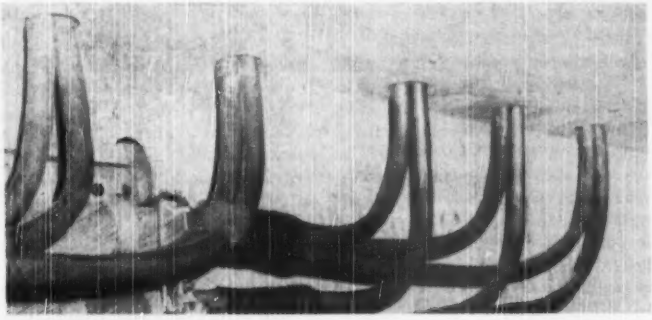
3 **TEMPORARY TIMBERS** formed curved foundation for rollers which guided cables over major bends in the run



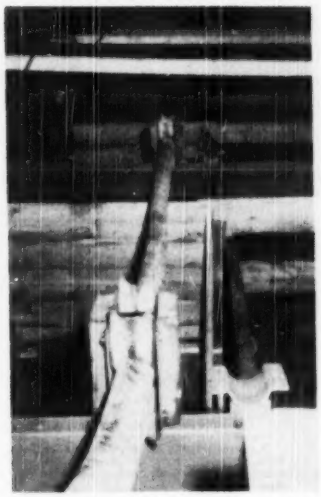
4 **CONNECTIONS** at generator were made without potheads because of the use of cables insulated with ozone-resistant compound. Steel armor wire did not require finish because the cable is not exposed to water or to corrosive conditions



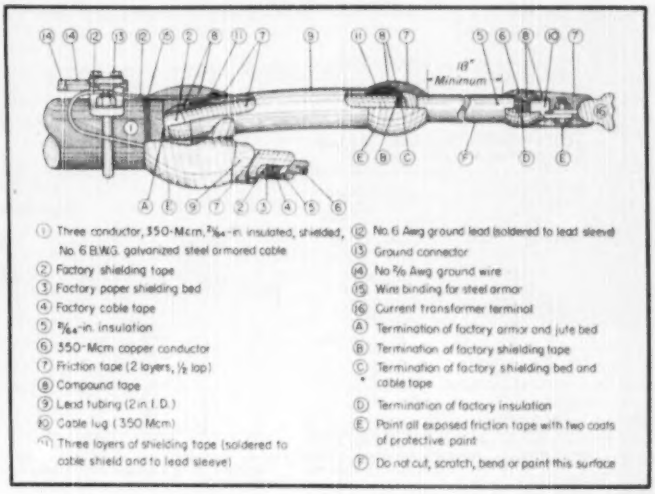
5 **CABLE GRIP** supports cable in case reel brake fails. Wood coverings on steel beams prevent scuffing of armor wire



6 **LEAD TUBING** protects cables in gatehouse basement as they enter switchgear housings above floor. Compound-insulated cable eliminated necessity of using potheads, an advantageous factor in the switchhouse where room was lacking for their use



7 **CABLE** comes down 275 ft to floor of generator house. Rollers were removed allowing cable to be placed in clamp



① Three conductor, 350-Mcm, 2/64-in. insulated, shielded, No. 6 B.W.G. galvanized steel armored cable
② Factory shielding tape
③ Factory paper shielding bed
④ Factory cable tape
⑤ 2/64-in. insulation
⑥ 350-Mcm copper conductor
⑦ Friction tape (2 layers, ½ lap)
⑧ Compound tape
⑨ Lead tubing (2 in. I.D.)
⑩ Cable lug (350 Mcm)
⑪ Three layers of shielding tape (soldered to cable shield and to lead sleeve)
⑫ No. 6 Awg ground lead (soldered to lead sleeve)
⑬ Ground connector
⑭ No. 2/0 Awg. ground wire
⑮ Wire binding for steel armor
⑯ Current transformer terminal
Ⓐ Termination of factory armor and jute bed
Ⓑ Termination of factory shielding tape
Ⓒ Termination of factory shielding bed and cable tape
Ⓓ Termination of factory insulation
Ⓔ Paint all exposed friction tape with two coats of protective paint
Ⓕ Do not cut, scratch, bend or paint this surface

8 **CABLE CONNECTIONS** at generator (illustration 4 above) and in switchhouse (illustration 6 above) were made in this manner. It was possible to use this type of connection because compound-insulated cable did not require potheads

Mechanical Strength Is Best Index To Insulation Life

Deterioration of insulation after 26 years of severe service is measured more accurately by mechanical strength than by electrical strength

C. L. SIDWAY, Electrical and Mechanical Engineer
Southern California Edison Co, Los Angeles

RESULTS OF TESTS recently performed by Southern California Edison show that it hopeless to judge even the rate of deterioration of cellulose insulation by its electrical strength. Actual tests of tensile strength, dielectric strength, and resistance to bending of transformer insulating material after 26 years of severe service indicate that mechanical strength is the only property to be used for judging insulation life.

Severe Operating History . . . When Edison recently rebuilt several large transformers for a change of voltage an attempt was made to evaluate the life remaining in old windings by examining and testing the old insulation. Operating history of the transformers had been unusually severe. Their rating, as installed in 1923, was 18,500 kva, 127/11 kv, 50 cycles. Loading on one bank was increased from 57,000 to 67,000 kva in 1931, and by 1935 cooling water sprays were installed because winding temperatures were frequently as high as 99 C. The sprays reduced winding temperature about 12 C. Beginning in 1944 winding temperatures were limited to 90 C by load reduction if necessary.

After some bushing failures the original bushings, conservators, and calcium chloride equipment were replaced in 1937 with oil-filled condenser-type bushings and inertaire equipment and the tanks filled with nitrogen gas. Oil tests in 1938 continued to show water getting into the oil, and the source was determined to be excess moisture in the winding insulation. The transformers were then given a special vacuum drying in the field. This vacuum drying, and operation for long periods at high temperatures would be expected to accelerate deterioration of the transformer windings.

Tests . . . Samples of the old winding insulation pressboard and coils were examined and tested. After preliminary inspection and discussion the insulation was tested for tensile strength, dielectric strength and resistance to bending. Identical tests were made with new pressboard so results could be compared, as shown. Samples were oven dried for about 24 hr before testing and kept under dry oil until used.

The old pressboard was in fairly good condition except for the sheets

How Tensile Strength of Old and New Material Compare

Old Material		New Material	
Sample	Tensile Strength psi	Sample	Tensile Strength psi
1	2,000	1	4,050
2	1,700	2	3,780
3	2,350	3	3,900
4	2,550	4	3,550
5	2,100	5	3,780
6	2,320	6	3,550 Min.
7	2,150	7	3,580
8	1,410 Min.	8	3,780
9	2,180	9	4,000 Max.
10	3,000 Max.	10	4,000
Avg.	2,176	Avg.	3,797

Data published for tensile strength of 1/16 in. thick pressboard gives 3,240 psi for new material, and 2,580 psi for pressboard aged one month in oil at 105 C. For pressboard aged 2½ years in oil at 105 C, the published tensile strength was 968 psi.

Bending Tests Compare Brittleness of Materials

Old Material				New Material			
Sample	Number of 30-deg Bends to Fracture	Sample	Number of 35-deg Bends to Fracture	Sample	Number of 90-deg Bends to Fracture
1	3	11	6	1	2
2	3	12	4	2	2
3	3	13	6	3	2
4	3	14	4	4	2
5	3	15	4	5	2
6	3	16	4	6	2
7	4	17	6	7	2
8	2	18	5	8	2
9	5	19	4	9	2
10	3	20	4	10	2

Samples 1-10 from different sheet of pressboard than Samples 11-20

Dielectric Strength Tests (Under Oil) Show Little Difference

Old Material 125 Mil Thick		New Material 100 Mil Thick	
Sample	Breakdown Volts Per Mil	Sample	Breakdown Volts Per Mil
1	320	1	350
2	376	2	400
3	376	3	420
4	360	4	340 Min.
5	342	5	350
6	313 Min.	6	410
7	393	7	400
8	370	8	430
9	440 Max.	9	440 Max.
10	400	10	440
Avg.	369	Avg.	397

Average dielectric strength of the old insulation 93% of the new material. Minimum dielectric strength of the old insulation was 92% of the minimum for the new material.

immediately against the core iron, which were hard and brittle. These sheets were not tested since it was obvious that they would have negligible tensile and bending strength. They still showed considerable compressive strength, which is the most important physical property for insulation used against core iron.

Bending Tests . . . Bending tests were made by measuring the angle through which the material could be bent and rebent over the edge of a wood mandrel with a corner radius of 1/32 in. An angle of bend was determined by trial that would just break the outer fibers on the stretched side of the sample. The sample was then reversed and bent through the same angle along the same line. This was repeated until the sample was completely fractured.

Angle of bend is considered to be the measure of flexibility. Number of reversals to fracture is less significant. Wide variation of bending strength made it impractical to select a common angle for all samples.

For making dielectric strength tests turn-to-turn samples were prepared from one of the high voltage coils. Turn and conductor insulation was in good condition. Although brittle, it was well-bonded to the copper.

Conclusions . . . Results of these tests confirm the fact that it is hopeless to judge even the rate of deterioration of insulation by its electrical strength. The dielectric strength tests show that maximum breakdown voltage for either old or new insulation was 440 v per mil. Minimum value for the old material was 92% of the minimum for the new material. Average difference between individual tests for the old material was 43 v per mil, and for the new material 32 v per mil. This is more than the difference between average breakdown voltages.

Average breakdown voltage for the old material (369 v per mil) is higher than the published value of 300 v per mil for new fullerboard under oil. Probable operating dielectric stress on the pressboard in this transformer would be about 30 v per mil. These results and comparisons indicate that as far as electrical strength is concerned, the pressboard tested was as good as new. Results of dielectric strength tests on the coil insulation turn-to-turn have led to the same conclusion.

Dielectric Tests Turn-To-Turn Show Electrical Strength To Be Good

Sample	Turn-To-Turn Breakdown Volts	Sample	Conductor-To-Conductor Breakdown Volts
1	30,000	1	1,600
2	24,000	2	1,700
3	26,500	3	5,000
4	20,000	4	1,600
5	26,000		
6	18,500		
7	20,500		
8	27,000		
9	24,000		
10	29,000		

Samples prepared from high voltage coil wound with four 0.290 x 0.290-in. double cotton-covered conductors in parallel per turn, with 0.125-in. pressboard for turn insulation. Completed coil was varnish impregnated when made.

Actual operating volts per turn for a transformer of this type would be about 170. Conductor-to-conductor voltage would be negligible.

Strength Best Criterion . . . Mechanical strength is the only property that can be used for judging life of insulation. Even this is not an absolute measure of actual life of a transformer due to lack of a proper criterion by which to judge if the insulation has reached an unsafe degree of deterioration.

As for tensile strength, the tests showed that the old insulation had about 50% of the strength of new insulation. However, it still showed a value almost as high as that published for pressboard aged only one month in oil at 105 C.

The bending tests show the greatest deterioration of the pressboard. Results of the test cannot readily be expressed quantitatively, but it appears that the old material has lost something more than 50% of its flexibility. In considering the importance of this property, it should be remembered that pressboard in a transformer is not subject to bending in any great degree after the transformer is put in service.

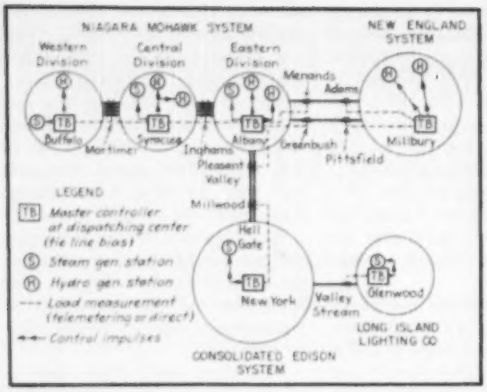
Tests Agree With Theory . . . A rough estimate of life of insulation theoretically used up in these transformers has been made using the generally accepted rule that insulation life will be cut approximately in half for every eight to ten degree centigrade increase of temperature. Winding temperatures were taken from station records, and some broad assumptions made as to the time these temperatures were sustained. Results indicate that about 60% of the life was used. This agrees reasonably well with the 50% value obtained from the tensile strength test.

Assuming that future winding temperature would have been 90 C continuously, it is estimated that it would have taken 18 years to reduce the mechanical strength of this insulation to nothing.

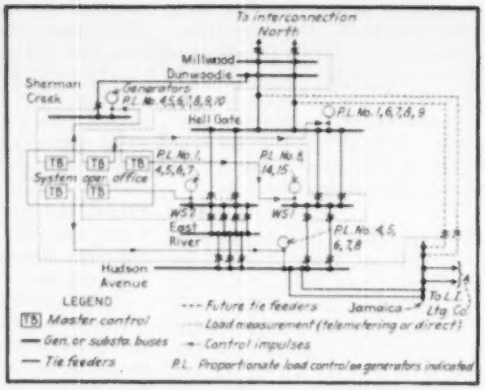
This does not indicate that the transformer would positively have operated 18 years more in service. However, the probability is about the same as it is for a new transformer to last 30 years. Actual life of an assembled transformer is only remotely related to the age of its insulation, and very few transformers fail by complete deterioration of the insulation. As the insulation becomes embrittled it becomes more vulnerable to hazards of abnormal conditions, such as short circuits, surge voltages, and vibration. Therefore, any of these conditions may cause premature failure before the insulation is wholly deteriorated.

Simple Cart Speeds Small Transformer Handling

EASE AND SPEED in handling distribution transformers in the shop is provided by the transporting device shown. It was made in the shops of California Electric Power Co from a pair of wheels and a welded scrap-pipe frame. A notched flat iron frame welded on top makes possible a rapid width adjustment to accommodate various transformer sizes. Use of this device was reported by Harry Bente, a transformer tester employed by California Electric Power Co, Riverside, California



LOAD-FREQUENCY control areas of Northeast Interconnection



LOAD-FREQUENCY control for the Consolidated Edison Co

Load-Frequency Control Brings Closer Tie Line Loading

System frequency control permits tie line load transfer to be closer to maximum tie line capacity. Idle capital investment is put to work

J. E. McCORMACK, Chief Distribution Engineer, and
C. N. METCALF, Assistant Engineer
Consolidated Edison Co of New York, Inc

AFTER SOME 20 years of progressive development, an effective method of load-frequency control—tie line bias control—is daily making an extremely valuable contribution to the efficiency and economy of the 5 power companies in the Northeast Interconnection.*

This control method makes possible a tie line load transfer a good deal closer to maximum tie line capacity than has hitherto been possible with past manual dispatching techniques. This is of particular importance today because of increased system loads and the need for using all available reserve capacity as well as maximum transfers of economy power. When frequency is permitted to vary and load swings are created, a greater operating margin must be maintained between ultimate tie line capacity and average load. Such a margin represents substantial capacity and capital investment which cannot be used. The reduction of this margin by tie line bias control allows the more efficient use of this capacity.

Starting with a balanced transfer with the load and generation constant in other parts of the interconnection, if the load increases in a particular area there will be an immediate flow of power into that area and the frequency will tend to drop due to the net deficiency. If generation is increased in this area, to meet load requirements, the tie line load and frequency will be balanced again. On the other hand, should the load drop in this same area, power will flow away from the area and the frequency will tend to increase until generation is reduced to restore the balance. When load changes take place outside a control area, creating a shortage, the power will flow out of the area and a decrease in frequency will result. Conversely, if there is a surplus in the interconnection outside of the area, power will flow into the area with an increase in frequency. Only when generation has been balanced with demand will prior conditions be restored.

Design of tie line bias method of control is based on these fundamentals. When there is a lack or surplus of power, all parts of the interconnection assist proportionately in restoring frequency until the specific area where the unbalance has occurred can take corrective measures. The amount each part contributes is determined by its established value of bias.

In tie line bias control, correcting impulses to the generating units are based on both the variation of tie lines load from the scheduled transfer and the deviation of instantaneous frequency from the nominal 60-cycle frequency. A bias setting—mega-

* These include the Niagara Mohawk System, the New England System, Central Hudson Gas and Electric Corp, Long Island Lighting Co and the Consolidated Edison System, with combined peak load of about 7,000,000 kw.

watts per 0.1 cycle—is selected which provides the control point from which the variations of tie line load and frequency initiate correcting impulses. For example, with a bias setting of 10 Mw per 0.1 cycle, if the instantaneous frequency drops 0.1 cycles low the control point is established at 10 Mw above the scheduled transfer. Variations of tie line load and frequency from this control point result in correcting impulses which will then establish the tie line load at this value.

Consolidated Edison has also adopted automatic proportionate loading between generating units at its stations for several reasons. Due to special design conditions of its system it is necessary to maintain the phase angle difference between bus sections within limits to avoid excessive unbalance in loading on network transformers, feeders and mains. Proportionate control insures a gradual and uniform change in the loading of all the units, thereby holding the phase angle displacement relatively constant between bus sections during load changes on the station.

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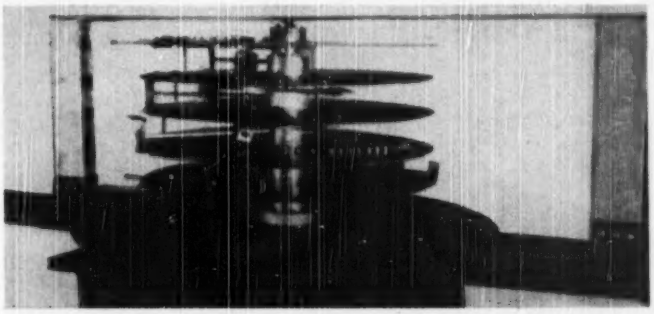


INCREMENTOMETER *readily gives optimum load to be carried by each of several power plants in a system. Division of load is obtained mechanically without any calculations, other than those necessary to establish input-output curves for each plant*

Unit Gives Optimum Plant Load

JOSEPH LEVITT, Physics Dept
Pratt Institute, Brooklyn, N. Y.

OPTIMUM division of load among a group of power stations comprising any generating system can be automatically computed by a machine from input-output data of each station. This machine, the Incrementometer, was conceived by the author and is based on the principle that the most economical operation is achieved when loads are divided so that incremental rates of the various stations are equal. Division of load is obtained directly without any calculations, other than those necessary to establish input-output data.

After obtaining performance data and applying them to the machine, a schedule of loading can be readily prepared in which individual units are loaded progressively at equal incremental rates to meet total demand.

The Incrementometer consists of several disks mounted on a vertical shaft and equally spaced. Disks are free to rotate about their common center with negligible friction. Each disk has a set of radial lines 12 deg apart. Starting from zero, each successive radial line represents an additional unit of output. Along the periphery of each disk is a corresponding uniform scale of output.

On each disk is plotted, in polar coordinates, performance data of a given generating station. Output is plotted as angular displacement (θ) and input as radial displacement (r). Performance curves are plotted in this manner: Starting with zero output ($\theta = 0$) corresponding input is recorded by inserting a bolt in a hole drilled on the zero radial line at the proper radial displacement. For the next value of output, corresponding input is entered by inserting a bolt at the proper displacement on the next radial line. This is continued until all performance data have been entered. A steel band tightened around the outside of the bolts on the bottom of the disk represents the performance curve. This procedure is repeated for other stations.

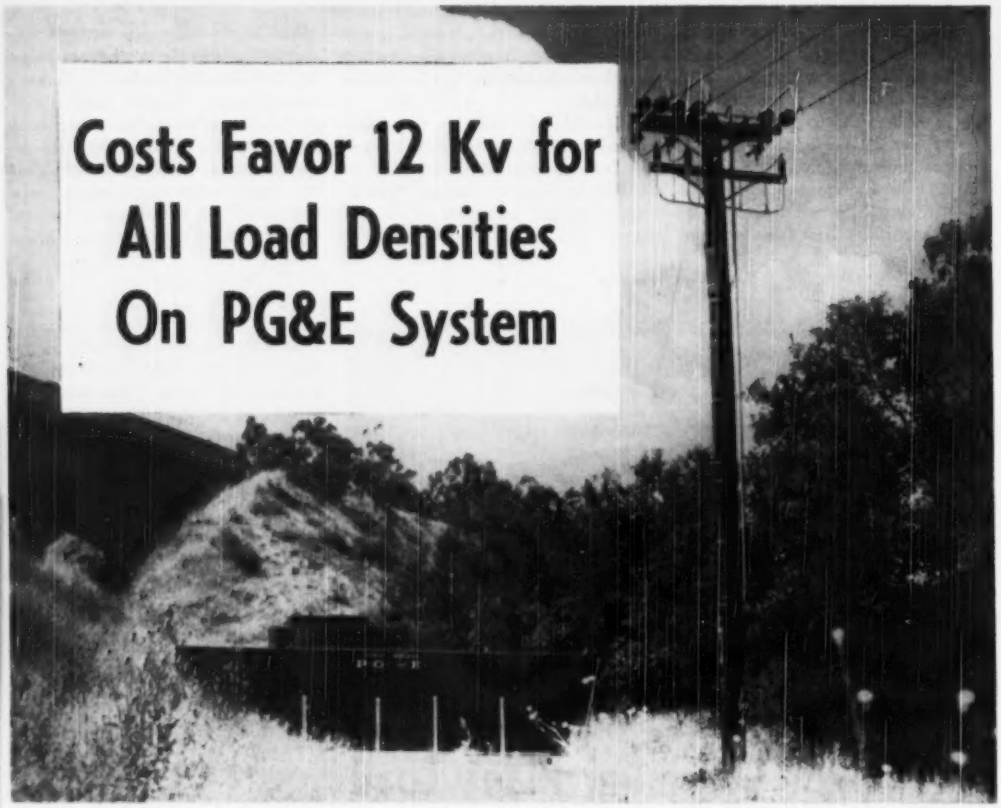
Mechanical connections between disks are made in this way. Each disk, except the top one, has a radial, horizontal lever connected firmly to its upper side. There is also a separately mounted lever beneath the bottom disk. On each lever is mounted a frictionless rider which is free to move radially in and out. The rider maintains rolling contact along the outside surface of the steel band on the disk above. Proper tension applied to the rider prevents it from moving away from this steel band.

To illustrate how the machine works, assume there are only three disks on the machine, each with a steel band representing a station performance curve.

The disk on the top is permanently fixed with respect to the shaft. Suppose that a total output of ten load units are to be supplied by the three stations. Levers of all disks are set initially at zero. To find the division of load, the master or lowest lever is rotated ten units on a fixed bottom scale (the totalizing scale). This movement is transmitted to the disks above through frictionless riders. Each disk will move a proportionate amount as determined by its steel band performance curve. Each lever will then indicate the proper output on the scale of the disk above it. In this case, output is three units on disk A, five on B and two on C.

The Incrementometer was designed and built by the author and Paul Soros and submitted on May 29, 1950 as thesis work toward a masters degree at Polytechnic Institute of Brooklyn. Work was assigned by M. J. Steinberg (also of Consolidated Edison Co of New York).

Costs Favor 12 Kv for All Load Densities On PG&E System



12-KV DISTRIBUTION would eliminate need for further duplication of transformer capacity typified by this 2,000-kva, 12/4-kv unit substation. It is part of 155,000-kva of duplicating stepdown capacity in the metropolitan Oakland area of PG&E

Savings in substations and feeders, plus decreasing spread between 4-kv and 12-kv transformer prices rule out 4 kv no matter what the load density

R. R. COWLES, Assistant Engineer of Electric Operations
Pacific Gas and Electric Co, San Francisco

CAREFUL ANALYSIS of a wide spread of load densities on the Pacific Gas and Electric Co system indicates that 12-kv distribution is more economical than 4-kv for all load densities. Study of areas with different types of load, and load densities varying from 110 kw to 3,400 kw per sq mi shows that there is no place for 2,300 or 4,160-v distribution, with the possible exception of very small towns where no expansion is contemplated or for a very small factory.

In comparing over-all cost figures, the principal saving with 12-kv distribution as compared to 4-kv is in the cost of substations and feeders. Important contributing factors are favorable comparative costs of overhead lines, decreasing spread in distribution transformer prices for the two voltages, especially in the larger sizes, and more economical methods of supplying substations.

Substations and Feeders . . . Major cost factor favoring 12-kv distribution is lower cost of substations and feeders. The most economical arrangement for supplying 4-kv distribution is by direct transformation from a transmission line, with the cost per kva of 60/4-kv substations varying considerably, depending on size, number of feeders, and size of feeder regulators (see table). A 3,000-kva substation with two 200-amp feeders costs about $38 per kva; lowest cost per kva for the sizes of substations adaptable to the type of load and area under discussion is $26.60 per kva for a 6,000-kva station with three 300-amp feeders. Bus

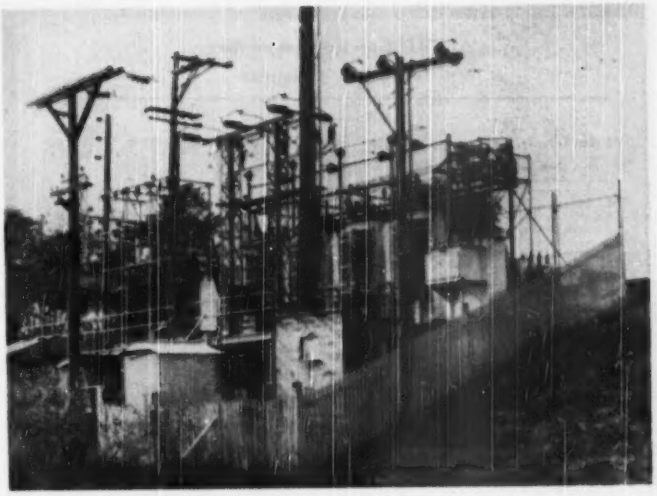
regulation for 4-kv stations costs less per kva (about 20% in this size) but has not been found satisfactory and is not recommended. Small zone stations of 2,000-kva capacity with one outgoing feeder can be installed for about $20 per kva, including regulation within the transformer.

A 12-kv substation supplied from transmission lines can be built for a much lower cost per kva because larger sizes can be advantageously utilized with fewer feeders, and bus regulation is usually satisfactory. For example, a 6,000-kva 60/12 substation with two feeders, as shown in the table, costs with bus regulation about $20 per kva, and with feeder regulation about $23 per kva.

Substation cost, including high tension equipment, transformers, and other equipment down to the low voltage bus, is the same for 4-kv as 12-kv stations up to about 6,000 kva, where the heavy secondary current required at 4 kv increases the cost somewhat. Above 7,500-kva capacity the 4-kv regulators must be equipped with reactors, which further increases the cost.

Overhead Lines . . . Under PG&E standards, there is very little difference in cost per mile between 4-kv and 12-kv overhead line. Five classes of insulation are used on the system, varying from designation AA along the seacoast to D in interior valleys and the Sierra Nevada mountains. Using 4/0 bare copper as a basis, the greatest difference is 4.2% in class B territory, dropping to 1.4% in C and D districts. Even in these class B areas, difference in cost for heaviest construction does not exceed $250 per mile; in AA and A districts the difference is only about $150 per mile, dropping to $60 per mile in class C and D districts.

Number 6 copper can be used on 12 kv for the same load and the same feeding distance where 4/0 copper is required for 4 kv. It is generally more economical, however, to use a larger conductor and increase the feeding distance with the higher voltage, thereby using fewer and larger substations with a consequent reduction in cost per kva. On the basis of saving in copper, the minimum saving of 12 kv over 4 kv, using No. 6 copper instead of 4/0, would be in the order of 55%. In other words, 12 kv with No. 6 copper costs a little less than half of 4 kv with 4/0 copper under the conditions most favorable to 4 kv.



DOUBLE TRANSFORMATION, such as in this 3,000-kva substation, would not be required for 12-kv distribution. Incoming 60-kv in this case is stepped down to 12-kv, and a second 1,000-kva bank steps the 12-kv down for the lower voltage feeders

Transformers . . . Difference in cost between 12-kv and 2,400 or 4,160-v distribution transformers becomes very small in the larger sizes, and the spread is becoming less as the use of transformers of the higher voltage increases. Taking as a basis of comparison PG&E's total 1949 requirements for 2,400 and 4,160-v transformers (5,406 units averaging 19.3 kva), installed cost would be $13.00 per kva. If all of these transformers had been purchased for 12-kv operation, cost per kva installed would have been $16.20, or a difference of $3.20 per kva.

Cost of the cutouts is practically a standoff. It varies with the insulation districts, but for C and D districts 12-kv cutouts actually cost less installed than 4-kv.

Comparative Over-all Costs . . . For a given load it works out advantageously to handle from three to five times as much load on a 12-kv as on a 4-kv station. The 9 to 1 ratio which applies to conductor efficiency for 12 kv compared to 4 kv does not apply to area served because for a given load density the total kva in the area will vary as the square of feeding distance.

In a given area where 4-kv load is supplied from five 3,000-kva substations, for example, the same load could be advantageously supplied at 12 kv from one 15,000-kva station. There is some diversity between stations which works to the advantage of the larger station but, even assuming a comparison on an equal kva basis, the five 3,000-kva stations at $38 per kva would cost about $570,000. The single 15,000-kva station with bus regulation would cost $240,000, and with feeder regulation about $280,000. These unit costs are relative, but are based on the same features and offer no advantage to either voltage.

Distribution transformers in this area would be expected to have a ratio of about 1.5 kva for every kva of substation capacity. Throughout the PG&E system this factor varies from 1.1 to 2, the average being 1.34. On this basis, 15,000 kva of substation capacity would supply 22,500 kva of distribution transformers. At a difference of $3.20 per kva for the higher voltage, the 12-kv transformers would cost $72,000 more than 4 kv. Even so the substation cost under the 12-kv plan saves $330,000 with bus regulation or $290,000 with feeder regulation, and in either case, the net saving in favor of 12-kv would be not less than $218,000, with 12-kv

TABLE 1—Unit Costs per Kva

60-Kv to 4-Kv Substations

BUS REGULATION

Station Capacity, Kva	3,000	4,500	6,000	7,500	10,000
Number of 4-kv Feeders					
1	$28.30				
2	30.50	$23.70			
3	32.60	25.10	$21.30		
4	.....	26.80	22.40	$22.80	
5	.....	.....	23.40	23.60	$21.50
6	.....	.....	.....	24.50	22.20

FEEDER REGULATION

Number and Size of 4-kv Feeders					
2 200 amp, 2,880 kva	$37.70				
3 200 amp, 4,320 kva	.....	$33.00			
2 300 amp, 4,320 kva	.....	28.80			
3 300 amp, 6,480 kva	.....	.....	$26.60		
4 300 amp, 5,760 kva	.....	.....	30.50		
5 200 amp, 7,200 kva	.....	.....	.....	$31.90	
4 300 amp, 8,640 kva	.....	.....	.....	29.00	
5 300 amp, 10,800 kva	.....	.....	.....	.....	$28.80
7 200 amp, 10,080 kva	.....	.....	.....	.....	33.20

60-Kv to 12-Kv Substations

BUS REGULATION

Station Capacity, Kva	3,000	4,500	6,000	7,500	10,000	15,000
Number of 12-kv Feeders						
1	$28.30	$22.10				
2	.....	23.60	$19.70	$20.70		
3	.....	.....	20.80	21.80	$19.10	$15.40
4	.....	.....	.....	22.40	19.80	15.90
5	.....	.....	.....	.....	20.50	16.40

FEEDER REGULATION

Number of 12-kv Feeders						
2	.....	.....	$22.60	$22.70	$19.70	
3	.....	.....	.....	.....	24.00	$16.90
4	.....	.....	.....	.....	.....	18.30
5	.....	.....	.....	.....	.....	19.65

feeder regulation, or $258,000 with bus regulation.

Copper used for 4-kv feeders would be more than adequate for 12-kv distribution. Each of the five 3,000-kva substations using 4-kv distribution would have 4/0 overhead feeders tapering off to smaller sizes at the edge of the serving area. Studies have shown that for actual areas the amount of copper required on a comparable 12-kv system would be less than on a 4-kv system.

This comparison does not include cost of building transmission lines to the substations. It will obviously cost considerably more to build transmission lines to five substations than to one, with correspondingly more difficult right-of-way problems.

Methods of Supplying Substations . . . PG&E distribution substations are either supplied directly from a transmission line or from a 12-kv feeder. The former method is the most economical, and where 60-kv lines are available a 60/4-kv substation offers lowest over-all cost. In certain localities such as the Salinas Valley, where 60-kv lines run up and down the valley, substations are located on or near the line at convenient intervals. Disadvantage of this method is that it is often difficult to build 60-kv lines into built-up load areas. With 4-kv distribution it is essential that the substation be located as close to the load center as possible, which is another disadvantage that does not hold for 12 kv.

The second method, supplying 4-kv stepdown stations from 12-kv feeders, is used extensively in localities like Oakland, San Francisco and the Santa Clara Valley. The 12-kv feeders can be brought into or near the load centers of built-up areas but this method requires duplicate transformer capacity and duplication of lines. Every kva of stepdown capacity must be duplicated in the substation which supplies the 12 kv. In the areas where this method of substation supply is used, 12-kv feeders and 4-kv circuits are on the same poles on many streets and roads, or on opposite sides of the same street. Obviously to serve such areas at 12 kv no more investment would be required in 12-kv feeder capacity, since the feeders already cover the area to be supplied.

Typical Areas—Agricultural . . . The several advantages of 12-kv over 4-kv distribution are illustrated by four of the typical areas chosen for study. First is the Salinas Valley, an agricultural area with 4-kv distribution. The accompanying table shows a comparison between the cost of the present system with its 31 4-kv feeders, and a 12-kv system which could serve the same area and load with only 11 12-kv feeders.

The system has become badly overloaded, making it difficult to maintain satisfactory voltage to customers even with individual feeder regulation. Some of the load is being changed to 12 kv, and it is contemplated that eventually all of it will be.

The ten substations which now supply the load represent a present day valuation in the order of $1,300,000. The same area and load could be served from three 12-kv substations aggregating 35,000 kva, at a cost of about $700,000, or a saving of approximately $600,000.

There are about 52,500 kva of distribution transformers connected to the 4-kv system. Allowing $3.20 per kva price difference for the higher voltage, increased cost for 12-kv transformers would be about $170,000, leaving a net over-all saving for this area, had it been constructed for 12 kv, of about $430,000.

Metropolitan Area . . . Five major transmission substations supply 280,000 kw at 110 kv to metropolitan Oakland and a surrounding area totaling 82 sq mi, with load density of 3,400 kw per sq mi. All the load is supplied by transmission substations at 12 kv, with some underground

cables in addition to the overhead lines. Of the 280,000 kva total, 155,000 kva is served from a 4-kv system, with nine main and 20 zone stations, all representing a duplication of 12-kv capacity. Average spacing of the 4-kv stations is 1.3 air miles or 1.8 miles via the circuit. Many main streets have both 12 kv and 4 kv on the same poles or opposite sides of the streets. In this case the 12-kv distribution system is adequate to supply the load directly, since the feeders are available and in the correct location.

At an average cost of $25 per kva for 12-kv to 4-kv stations, duplication of 155,000 kva of capacity amounts to $3,900,000. At $3.20 per kva price difference for 12 kv, approximately 200,000 kva of distribution transformers in the area would cost an additional $640,000, leaving a saving of $3,260,000 in favor of 12 kv for this metropolitan area.

All 12-kv vs 12 and 4-kv . . . Two other areas studied permit direct comparison of service entirely by 12 kv and service partly at 12 and partly at 4 kv for predominantly agricultural areas. The Santa Clara Valley with a load density of 256 kw per sq mi requires 18 substations to supply the total peak of 75,000 kw. Of this 75,000 kw, 37,000 is served directly at 4 kv from transmission substations, and 27,000 is served from 12/4-kv stepdown or zone substations. There is a great deal of duplication of capacity in the 4-kv zone substations, and as in Oakland there is considerable duplication of 12-kv and 4-kv circuits, often on the same poles.

The other area, in the San Joaquin Valley, is served entirely by 12-kv distribution. Total load of 51,900 kw in an area of 470 sq mi, with load density of 110 kw per sq mi, is served by five 12-kv substations averaging 12,000 kva (compared to the 18 4-kv stations in the Santa Clara Valley). Bus regulation only is used and has generally been found to be satisfactory. Voltage charts at various locations show the voltage delivered from these 12-kv lines to both urban, suburban and rural customers is as good or better than on the 4-kv system in either the Santa Clara or Salinas valleys.

With one exception the largest conductor used on any of these 12-kv feeders is 1/0, close to the substation.

TABLE II—How 12 Kv Would Save One-Third In Salinas Valley
(Now Served at 4 Kv)

Area, sq mi	260	
Load density, kw/sq mi	136	
Distribution transf., total kva	52,500	
	4 Kv	12 Kv
Substations required	10 60/4 kv	3 12 kv
Feeders required	31 4 kv	11 12 kv
Distance between subs, mi	4.35	13.0
Total present day cost of subs	$1,395,000	$705,000
Gross Saving for 12 kv		$690,000
Additional cost for higher voltage distribution transformers at $3.20 /kva		170,000
Net saving for 12 kv		$490,000

Farther out on the circuit the conductors are generally No. 2 or No. 4, as compared to 4/0 copper used for practically all of the 4-kv feeders in the other areas. Average distance between substations is 15.4 mi compared to 3.8 in the Santa Clara Valley area.

Conclusions . . . In summary, the economic advantages of 12-kv vs 4-kv distribution are:

1. Fewer substations, larger size and lower cost per kva.

2. Fewer feeders, larger loads per feeder at lower cost and less congestion of pole lines on streets.

3. Substations can be located within convenient distance of transmission lines, thus avoiding double transformation.

4. The 12 kv permits expansion more readily both in area and in load density.

It must be realized, however, that changes cost money, and every time the question of a major change from 4 kv to 12 kv is considered the cost per kva is usually quite high. Usually it costs less and appears more expedient to install a zone station or a small stepdown bank than to cut over to 12 kv. It should be clearly understood, however, that the longer a cutover is postponed the more it will cost, since the 4-kv system continues to grow.

It is not the purpose of this paper to advocate the wholesale cutting over of large areas of 4-kv distribution to 12 kv. A logical solution appears to be to confine the 4 kv, not permitting it to grow beyond its present area nor increasing substation or feeder facilities. Rather, substation capacity should be kept within its present limits, and the fringe load cut over to 12 kv. Above all, no 2,300-v distribution should be changed to 4 kv. If any change is made, it should be a change of definite advantage that will permit further expansion—in other words, from 2,300 to 12,000 v.

In addition to the economical advantages, some of the operating advantages of 12 kv over 4 kv are:

1. Better relay operation, particularly with ground faults.

2. In the opinion of men doing hot line work on 12 kv, it is safer than working on 4 kv with rubber gloves.

3. Fewer fatal accidents on 12-kv lines than on 4-kv lines of the PG&E.

4. Analysis of distribution feeder interruptions does not indicate any more interruptions on 12-kv circuits for the same conditions than will occur on 4 kv.

Electric Heater Keeps Bushings Moisture-Free

FAN-TYPE electric heater, set on the floor of the bushing storage room in the maintenance department shop of Duke Power Co, Charlotte, N. C., keeps the insulators dry and decreases the tendency for moisture condensation. Otherwise the moisture would contaminate the insulating oil when the bushings are installed. Capacity of the heater is 3 kw.

Tarpaulin drop curtains are used to enclose the area to increase the effectiveness of the heater. Curtains are rigged on overhead track hangers and are easily and quickly pulled back when bushings must be moved.

J. B. Brown and R. P. Chapman of the maintenance department shop originated the idea.

89 cold storage plants on firms in company's territory have fruit storage capacity of from

"Electric Farming" Boosts Farm

Pumping and dikes reclaim wasteland; cold storage on farms holds fruits for best prices. Company revenue reaches $77 per farm on 103,000 farms

RESEARCH, development and promotion in the rural field were important factors that pushed Consumers Power Co past the 100,000 farm customer mark recently. Average annual revenue has reached $77 per farm.

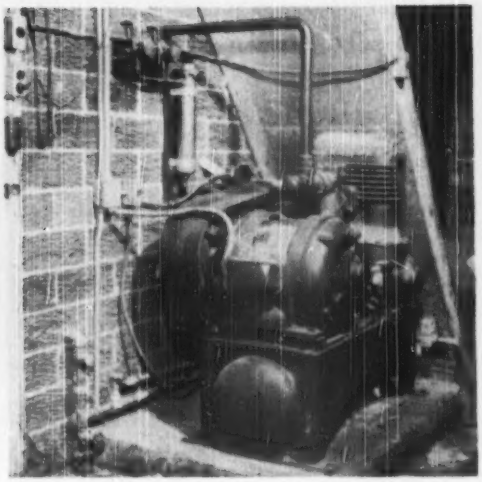
Conspicuous achievements have been the reclaiming of waste lands, sharp increase in farm production, lower production costs, and better prices because of quality or other factors such as cold storage for fruits. One farm in the fruit growing area put in a 50,000-bu cold storage capacity and reported that increase in profits paid for the installation in one year. The peach crop was held off the market from 10 days to two weeks, and then this was repeated with the apple crop. The differential in market price of the two crops took care of the investment in cold storage facilities.

There are 89 plants having a total capacity of 1,366,500 bu for the cold storage of fruits in the company's territory. These range in size from 6,000 to 100,000-bu capacity. The company, in cooperation with Michigan State College, was instrumental in early developments and promotion that proved the value of cold storage facilities. Fruit men estimate that it costs $1.50 per bu of capacity to build a storage plant complete with refrigeration equipment.

If you ask a grower what kind of return he receives on his storage investment he will tell you that it varies. Energy cost is low, estimated at 4¢ per bu for apples which require an estimated 1.22 kwhr per bu for a season's storage. Length of the storage period and differential in price between immediate sale and sale after storage determine the return on investment. Many growers also store peaches, plums, and pears for a short time in the fall before the apple crop is harvested. In some seasons price differentials are sufficient to write off the entire storage investment in a single season.

Onion Drying Plants . . . Making further use of the availability of electricity, a storage building was equipped with ducts and supplementary heat for drying onions. This eliminated weather uncertainty which plagued the outdoor onion drying process. There are 19 onion drying plants in the company's territory. They have a capacity of 410,000 bu. Here again the Consumers Power Co and Michigan State College did research and promotion on the program.

Perhaps the most spectacular and far-reaching of all the rural electrification activity has been the reclaiming of marsh land along the upper reaches of the lower Michigan peninsula. In cooperation with The Muck Growers Association, Consumers Power Co in 1939 launched an experiment in this field by erecting a dike that cut off 30 acres of this land from the lake. Pumps were installed to operate on float valve controls. Water was pumped out and the land was made suitable for cultivation. Soil was rich and full of humus which made it ideal for raising



6,000 to 10,000 bu each and cost about $1.50 per bu of capacity including refrigeration

Income and Ups Energy Sales

celery and onions. Crops yielded $1,800 to $2,200 per acre.

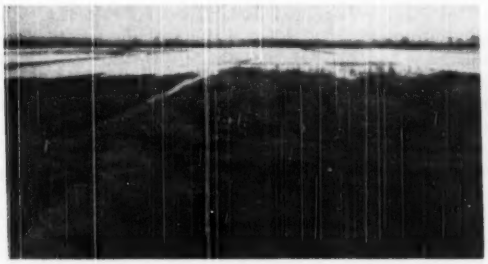
Today this modest experimental beginning of 30 acres has grown to some 3,000 reclaimed acres of the richest soil, capable of producing the most valuable crops.

Following a study of this activity the Farm Service Advisor reported: "Most of the land drained is of muck varying from 6 to 30 ft in depth. During rainy weather, or when the lake is high, moisture can be controlled at a predetermined level. In summer it is never too dry because capillary action produces the required moisture. Cost of clearing and diking runs from $200 to $500 per acre depending upon timber growth, stumps, unevenness of ground and ability to get necessary fill for dike. Average cost is estimated at $350 per acre. Average selling price of good-grade deep muck land, prepared for tilling of vegetables is estimated at $750 per acre. Many farms in the area could not be bought for $1,000 per acre."

This activity has been responsible for the establishment of celery growing on a major scale in the Muskegon area.

Poultry Raising . . . Poultry raising on the Charles Delamarter farm near East Lansing is a good example of what has been accomplished in that field. The farm is equipped with incubators, brooders, running water, lights, an electric range, an 18-cu ft freezer, and other electric appliances to make the home and business pleasant and profitable.

Three incubator and hatcher units of 12,000-egg capacity produce 40,000 chicks per hatching season. A combination of good incubators and brooders, years of selective breeding, and good feeding and management



Before . . .

Over 3,000 acres of marsh land that looked like this have been turned into soil rich in humus on which celery, onions and other

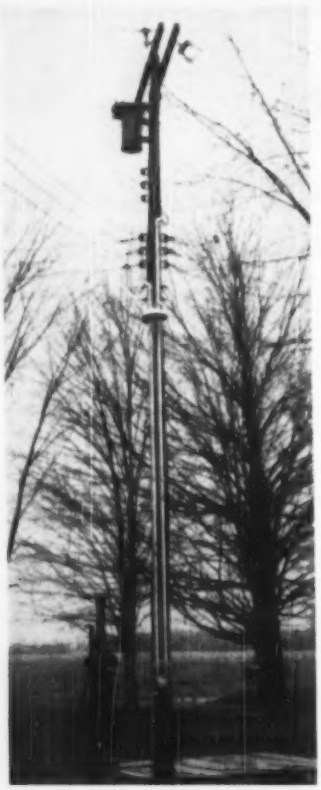
After . . .

vegetables thrive like this to produce crops valued up to $2,200 a year per acre. Land values now run as high as $1,100 per acre

Electrical equipment produces prize fowl on Michigan farm

High hatching percentage as evidenced by full tray of chicks just taken out of incubator is due to good incubators and brooders, selective breeding, good feeding practices

Charles Delamarter is shown here with brooder and prize New Hampshire cockerel. Three incubator and hatcher units (12,000-egg cap.) produce 40,000 chicks per season



Kwhr jumped 46% . . .

following installation on the farms at company expense, of central distribution poles, or maypoles as they have become known. More than 1,500 of them have been installed

practices, pays dividends in high hatching percent as shown in the picture of a tray just taken from the incubator.

Numerous blue ribbons have been won in county, state, and regional competitions. In 1948 the Delamarter chicks were selected for the national "Chicken of Tomorrow" competition. Usually the flock produces several hens that lay 300 eggs each year.

An 18-cu-ft freezer is used for freezing dressed fryers and hens for the retail trade. Most of the Delamarter produce goes on the retail market. His, like hundreds of other poultry farms that have electrical equipment, is a very profitable business. Some of these poultry farms have radiant heat installed in the floor and use this with hovers for brooding chicks.

On the Delamarter farm, electricity used was 11,848 kwhr in 1948 and 12,942 kwhr in 1949.

Central Pole Distribution . . . Since 1946 the company has been installing central pole, "maypole," distribution systems on farms at no cost to the farmer. They are only installed when the farmer has exceeded the capacity of his original 3-wire, 60-amp service switch and is ready and willing to install a larger service and more adequate wiring.

To date there have been 1,531 of these systems installed. A 12-months check on use of service before and after "maypole" distribution was installed showed that use of service increased 46.8%. Made on 82 farms, the test showed 448,236 kwhr used the year prior and 657,780 kwhr the year after the installation.

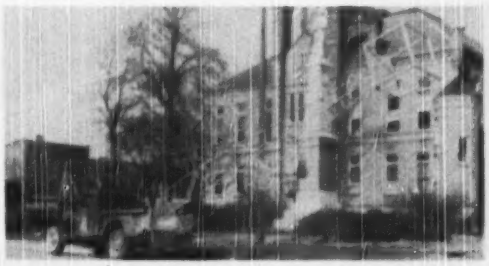
Cooperation with Michigan State College is very close and has been a major factor in the advancement of electrical operations on the farm. The work is carried on through a state committee consisting of six members, two each from the Michigan State College Agricultural Engineering Department, the Michigan Electric Light Association, and the REA cooperatives. This committee organizes programs and plans methods of procedure for accomplishing desired objectives. The many research projects and promotional activities under the direction of this committee have been a big factor in the rapidly expanding uses of electricity on the farm in Michigan.

Radio Program and 4-H Clubs . . . One activity under its direction has been a radio program, sponsored by the power companies and planned and directed by the committee. The program features new ideas for using electricity on Michigan farms. These are gathered by farm service representatives, county agents and others who contact farmers regularly. It has proved popular with farmers and helpful to them. It has also been valuable as a tool for expanding the use of electricity on farms.

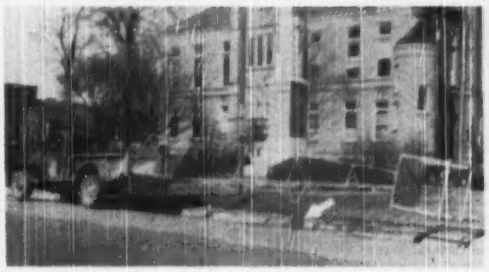
Working with farm youths of the 4-H Clubs to develop their knowledge of electricity and its uses on the farm is an important part of the company's program. It started on a county level in 1939 with an enrollment by the end of the year of some 300 4-H members. During 1940 and 1941, membership climbed to 400 and then over 500. This was followed by a decline throughout the war years to about 125 in 1944. With the end of the war, and more vigorous promotion by the company, membership reached above 300. After developing into a system-wide activity in 1946, membership bounded to almost 4,000 in 1949. It is the most time-consuming of any work in the rural program, but it places the company representative in direct contact with customers of tomorrow who are future leaders in agriculture, teaching, industry, politics and religion.

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

MAINTENANCE TOWER . . .



WHEN LOWERED . . .



BECOMES TRAILER . . .

Street light maintenance is carried out easily and economically by a lightweight tower which becomes a trailer. On location, the tower is raised and lowered by a front-end winch. In trailing position the tower rides on a single swivel wheel (*arrow above*)

Tower-Trailer For Small Town Street Light Maintenance

V. C. PRICE
Asst to Executive Vice President
Iowa Southern Utilities
Centerville, Iowa

A TOWER which becomes a trailer is Iowa Southern Utilities' solution for economical street light maintenance in medium or small-sized towns having a limited number of "high-level street lighting" fixtures. This tower eliminates the need for a truck unit especially adapted to street light maintenance. For work on fixtures 30 ft high and higher, it is also much safer than unstable lightweight extension ladders mounted on trucks. The tower was developed in cooperation with Fuller Mfg Co, Centerville, Ia.

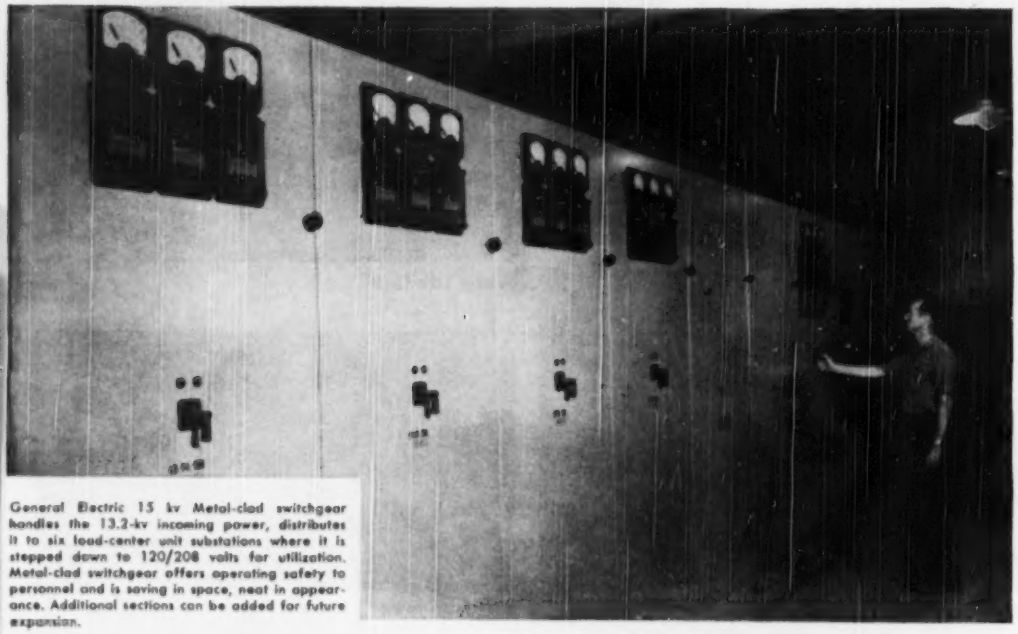
This tower does not tie up a truck permanently. When needed, it is attached to a truck by three wing studs through the floor of the truck bed into the frame. Because of its light weight, the tower can be handled easily by two men. On location, the tower is raised into working position by a front-end winch. The platform is large enough and safe enough to give workmen confidence when working on, relamping or washing fixtures. In addition, rungs on one leg of the tower make climbing safe and easy.

In the trailing position the tower rides on a single swivel wheel and is reportedly very maneuverable. With the tower mounted on the type of truck shown, it is not necessary to use jacks to obtain stability. With lighter trucks jacks probably will be necessary. Development work is now in progress to build a tower of lighter materials so that it can be pushed up by hand instead of being pulled up with a winch.

Pike Pole Disassembles For Ease in Travelling

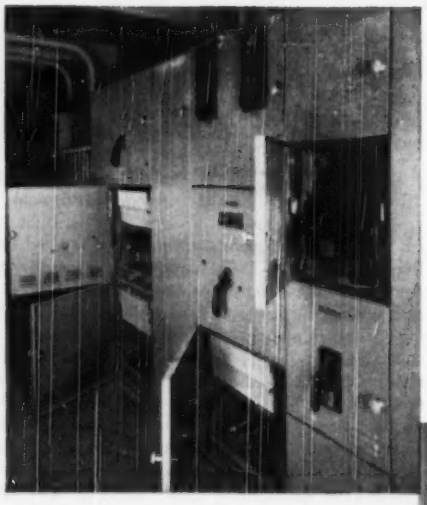
DETROIT EDISON CO engineers have designed a jointed pike pole which separates into two sections for convenience during travel. A standard 16-ft pole was cut and fitted with two chromium-plated steel tubes which slip one inside the other. A spring-loaded ball bolt holds the pole sections together during use.

METAL CLAD SWITCHGEAR



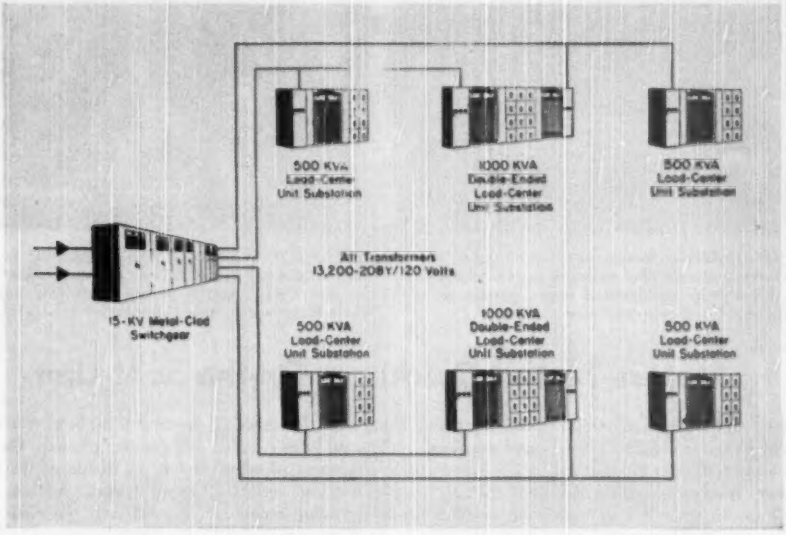
General Electric 15 kv Metal-clad switchgear handles the 13.2-kv incoming power, distributes it to six load-center unit substations where it is stepped down to 120/208 volts for utilization. Metal-clad switchgear offers operating safety to personnel and is saving in space, neat in appearance. Additional sections can be added for future expansion.

Load-center unit substations receive 13.2 kv power and step it down to 120/208 volts for utilization. Air switches on primary are easy to operate, blades are easy to see. Note entire load-center is metal-enclosed thus offering operating safety to personnel.



Low-voltage end of load-center unit substation showing air circuit breakers that have plenty of "IC" (Interrupting Capacity) to handle all short circuits. Breakers are of the drawout type, easily removable for inspection or maintenance.

HELPS PROTECT SERVICE AT TELEPHONE COMPANY INSTALLATION



In this installation General Electric Metal-clad switchgear receives the incoming 13.2 kv power and distributes it to six G-E load-center unit substations. Three load-centers, two single-ended units rated 500 kva and one double-ended rated 1000 kva, are located in the basement. Three other units of identical rating are on an upper floor. From these load-centers utilization circuits feed 208/120-volt power both upwards and down, and provide efficient, low-cost power at constant voltage wherever desired.

This installation is a complete General Electric project —one source of responsibility plus the very best in coordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

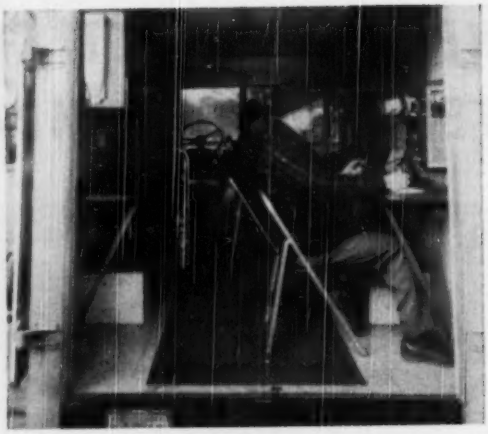
MODERN INDUSTRIAL power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want proper voltage for top performance of equipment, an extremely flexible setup to take care of expanding or changing loads, adequate short circuit protection, safety to personnel, and low installation and maintenance costs.

INVESTIGATE TODAY the many advantages of using General Electric switchgear in *your* plant for efficient, flexible power distribution. Contact your G-E sales representative for further information—or write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

GEA-3083	**Metal-clad Switchgear**
GEA-4966	**Low-voltage Metal-enclosed Switchgear**
GEA-3592	**Load-center Unit Substations**
GEA-3758	**Load-center Power Distribution**

GENERAL ELECTRIC

MOBILE UNIT provides on-the-spot test shop for testing and repairing socket meters of residential and small commercial customers. Information painted on the truck explains purpose of truck and helps to identify crew as utility company employees



TEST SHOP is manned by crew of three and houses test panels, work benches and storage cabinets. Fluorescent lighting, air conditioning and electric heaters provide comfortable working conditions. Power is obtained by cable from customer's meter socket

Meters Tested Quickly in On-the-Spot Unit

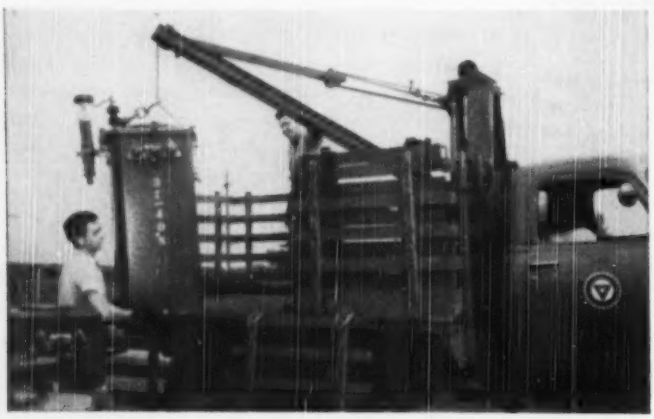
Residential and small commercial meters on the Duquesne Light Co system are quickly tested on-the-spot in meter testing trucks designed and equipped by the company's meter division. Two such trucks, operating in the Pittsburgh residential area, have permitted crews of three men to test 60 meters per 8-hr day—a 20% increase over shop testing.

Trucks are ¾-ton, walk-in panel type and house two test positions for socket meters. Equipment for testing and repairing meters includes panels with conveniently arranged switches for making proper test connections, two benches for minor meter repairs, and six lockers for meter parts and supplies. Fluorescent lighting, a ventilating system and electric heaters assure comfortable working conditions the year round.

Power for operating the test and repair equipment is obtained by connecting a cable to a meter socket on a customer's house. Customer's service is not disturbed while his meter is being tested. A "jumper jack" is plugged into the meter socket when the meter is removed, thus providing continuous service. Men in the crew take turns testing meters and carrying them to and from customer sockets.

Information painted on the truck body helps to explain the work that is being done.

• • •



HEAVY MATERIALS are handled easily by this ¾ ton crane on the materials handling truck. Materials are delivered prior to beginning work by the special crew. Results—more material delivered, less heavy work, more time devoted to line work by the line crews

Truck Crane Hastens Material Delivery

L. J. RENAS
Supervisor, Overhead Line Dept

S. MORITZ
Asst Supervisor, Overhead Line Dept
The Dayton Power and Light Co
Dayton

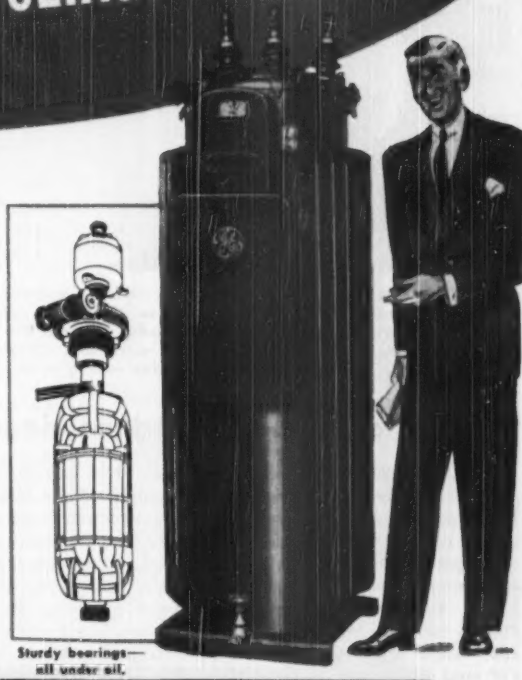
For many years past, materials and supplies have been loaded on construction crew line trucks and hauled to the site of construction, and in some cases never completely unloaded until construction was completed. This method impeded the acquisition of tools from the truck bed and at best was an awkward method of getting material when needed.

The Dayton Power and Light Co is

Requires Less Maintenance

than any other regulator you can buy...

GENERAL ELECTRIC IRS INDUCTION VOLTAGE REGULATOR



Sturdy bearings—all under oil.

★ **No contacts in the main circuit.**

★ **No cams or springs or elaborate gear trains.**

★ **No mechanical brake to adjust, no separate braking circuit.**

★ **Even the oil lasts longer—because the tank is sealed to stop all breathing.**

General Electric IRS induction voltage regulators give accurate, stepless regulation—with no time-delay. They respond immediately and will correct the voltage at an average rate of 1 per cent in 1½ seconds throughout the entire range of ±10% regulation.

And—no other regulator can match them in low maintenance costs. Ask for Bulletin GEA-2985.

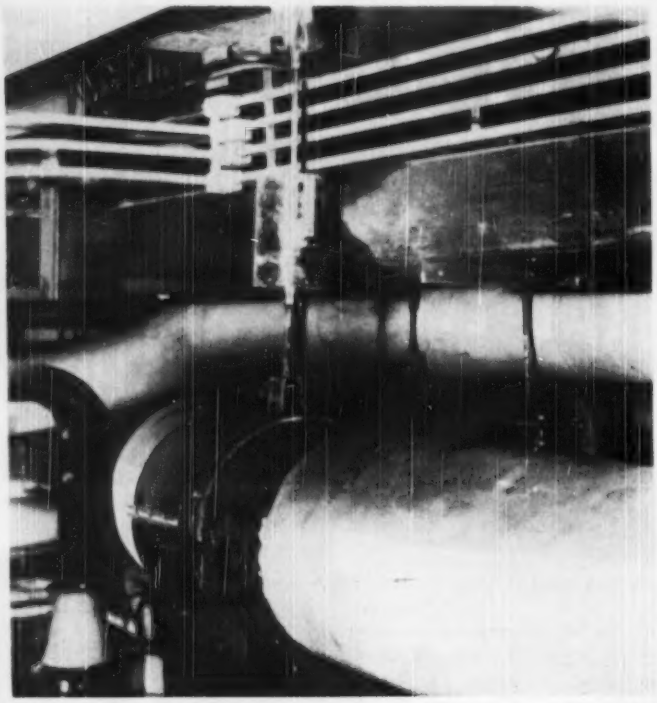
Apparatus Dept., General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

now making material deliveries with a truck having a ¾-ton crane which is capable of handling all types of material including transformers weighing up to 1,500 lb. All materials are requisitioned, and distributed by the personnel of the material handling crew. It is delivered prior to work commencement. The crane facilitates handling of heavy materials, reduces the amount of heavy work of the material handling crew and increases the amount of material they can deliver.

Economy of this method of material distribution is realized by the increase in time for line crews to participate in line work rather than material handling.

•



INSULATED PIPE HANGER carries main steam line at Tyrone Station of Kentucky Utilities Co. This specially designed assembly is used on a 10-in. pipe with 5-in. insulation for 910 F steam. Hanger consists of flanged band, saddle plate and filler bar, around which is fastened a strap for suspension by a standard pipe support. Weight of pipe rests on magnesia insulation which has been tested for loading capacity at 100 lb per running inch

Insulated Supports Reduce Heat Losses

INSULATED SUPPORTS, so-called, are being used to prevent excessive heat losses due to direct metal-to-metal contact between hot pipe surfaces and structural supports. In this type of installation, developed by Sargent & Lundy, Engineers, from test work done at the University of Illinois, the entire length of piping is insulated in the usual manner and then supported by hangers or by channel irons.

Where the piping is to be supported by a hanger, a No. 10 gage steel plate, its length proportioned to the load to be carried, is rolled into a band to fit the insulated pipe and provided with a flange for assembly (see illustration). A saddle plate, ¾ in. thick, is then tack welded around the lower half of the flanged band to assist in carrying the direct load and in spreading it over a wide area. The unit is then bolted in place around the insulated pipe, a filler bar is fitted over the upper half of the flanged band, and the usual hanger strap is fastened around the entire assembly.

Where the pipe line is to be supported by channel irons, a 16-gage sheet metal band, 18 in. long and flanged for assembly, is bolted around the insulated pipe at each point of support.

Loading Capacity

Since the pipe rests on the insulation at the supports, the insulating material used must be able to bear the weight of the pipe. On the basis of the tests conducted at the University of Illinois, a loading capacity of 10 psi or 100 lb per running in. of line, has been established for 85% magnesia.

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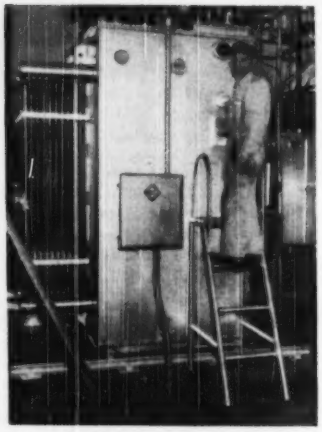
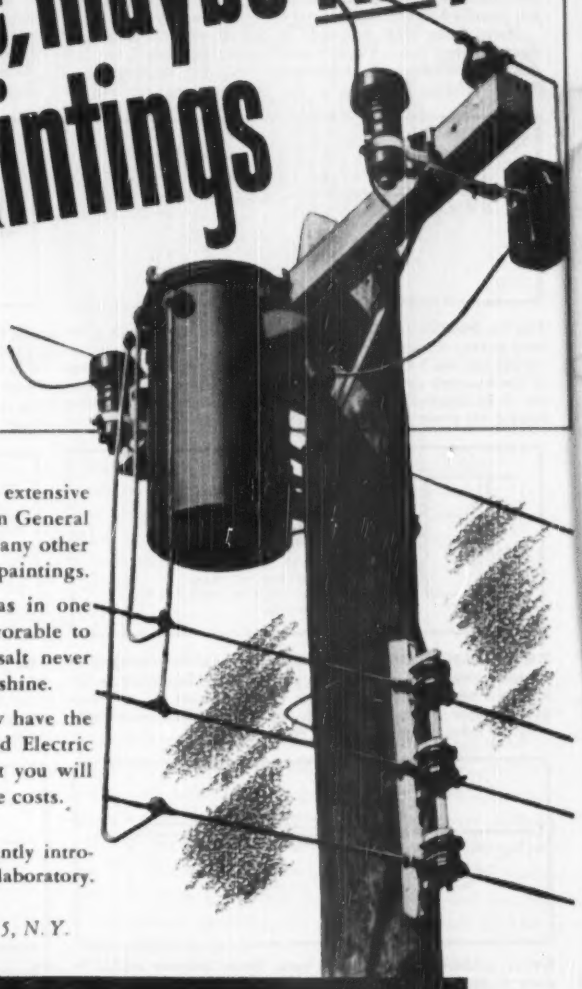
Substation Ladder Aids Regulator Checking



SUBSTATION LADDER aids operator in checking the regulator and its range and the veedor counter. It is made of 1¼-in. steel uprights, 1-in. rungs and a ½-in. circular hand rail. The ladder is painted with aluminum paint to match other equipment in the station. Two legs of the ladder rest on the concrete footing while the other two rest on a piece of creosoted timber buried flush with the ground. C. A. Coker, Fernwood plant operator, Mississippi Power & Light Co, designer and builder of the ladder, finds it useful for checking a 750-kva regulator. Several more similar ladders built by Mr. Coker are now in use at other substations where regulator height justifies the need

SPIRAKORE®
TRANSFORMERS

Save one, maybe two, repaintings



San Diego Gas and Electric has been running extensive tests on paint finishes. The Melaglyp* paint on General Electric transformers, they say, is superior to any other paint tested. It will save one, maybe two, repaintings.

This is testimony from a company that has in one location almost every condition that is unfavorable to paint: Salt spray. Dry spells during which salt never washes off. Heavy dew. Intense California sunshine.

Your own G-E Spirakore Transformers now have the same Melaglyp paint that San Diego Gas and Electric has found so superior. We are confident that you will find that this paint is cutting your maintenance costs.

*A melamine-modified-Glyptal® paint just recently introduced as a result of work by the G-E Pittsfield laboratory.

Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

402-99

Adjust Regulator Compensators to Meet Effects of Capacitors

W. L. PETERSON, Engineer-in-Charge of Sales, Regulator Section, Allis-Chalmers Mfg. Co, Milwaukee

AS MORE AND MORE capacitors are being added to feeders, the question being raised is how to adjust line-drop compensation of voltage regulators to meet capacitor effects.

Circuit sketches and vector diagrams are shown to help indicate how to make correct adjustments when capacitors are installed at the load center or at the regulator.

Many times it is desirable to install capacitors beyond the regulator, but not at the load center. In some cases, it is desirable to switch the capacitors. This may upset the load center voltage but usually the regulator control can be adjusted to give satisfactory line voltage in any case.

In the case where the inaccuracy is appreciable, correction can be applied by over-compensating with the resistance element and under-compensating with the reactance element. A few vector diagrams of existing conditions may help to determine the correct settings. Also, a recording voltmeter at the load center is often of great help. If the voltage should be low at light load, when the power factor tends to become leading, increase the value of the resistance element and decrease that of the reactance element.

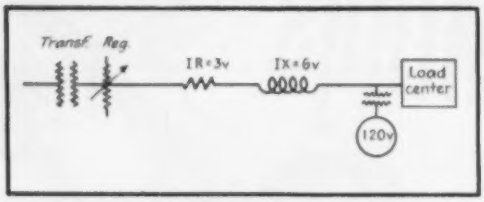


FIG 1—POWER CIRCUIT with feeder voltage regulator. It is desired to keep the load center utilization voltage at 120 v. The transmission line has 3-v resistance drop and 6-v reactance drop in terms of the line drop compensator settings. It is assumed that capacitors are to be installed at the load center and that reactive kvs flows through the power circuit as well as the line-drop compensator circuit

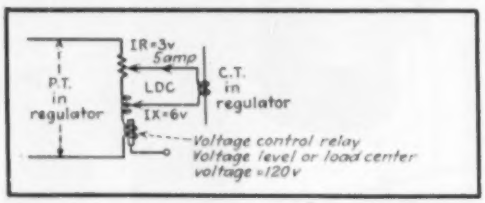


FIG 2—BASIC CONTROL CIRCUIT of regulator consisting of voltage control relay and line-drop compensator (LDC) is set for 3-v resistance and 6-v reactance. These values represent the resistance and reactance of the power circuit. The voltage control relay maintains the voltage level of 120 v at the load center

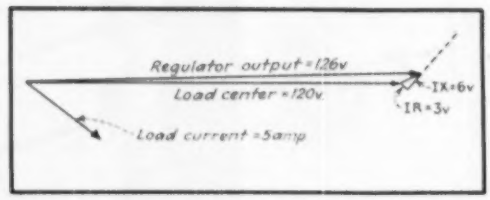


FIG 3—LAGGING power factor load. Vector diagram applies to power or regulator control circuit. Load center voltage, 120 v, (also, voltage level of control relay) is a reference. Full load current, 5 amp, in current transformer secondary requires output voltage of regulator to be 126. If reactance element of LDC is increased, reactance drop will follow dotted line. Regulator will raise its output voltage to maintain 120-v level in control relay, and thus at load center

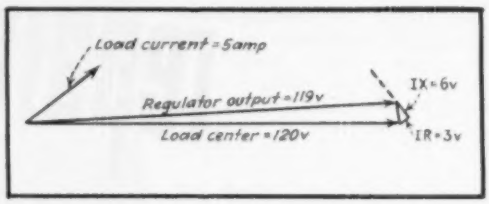


FIG 4—LEADING power factor load. Vector diagram is applicable to either the power or regulator control circuit. If load center voltage is to be maintained at 120-v, regulator output voltage must be 119 v. Should reactance setting of the line drop compensator be increased, the reactance drop would follow the dotted line. The regulator must lower its output voltage to maintain the 120-v load center level

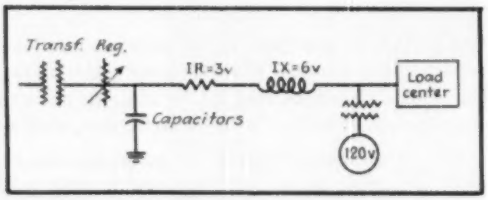


FIG 5—IF CAPACITORS are installed beyond the regulator, other than at the load center, the line-drop compensator settings of the regulator will not produce the correct voltage at the load center. For an extreme case, consider the capacitors installed at the load terminals of regulator as shown. See Vector diagram in Fig. 6

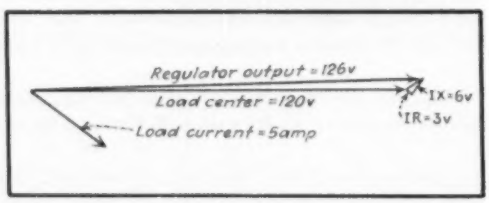
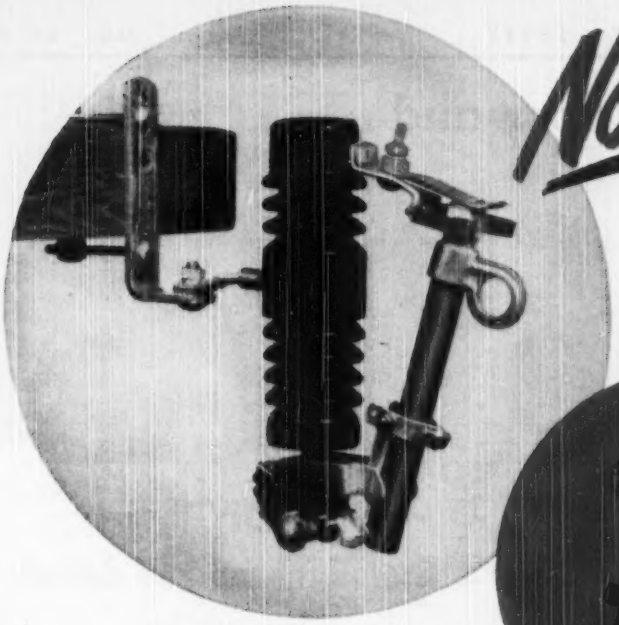
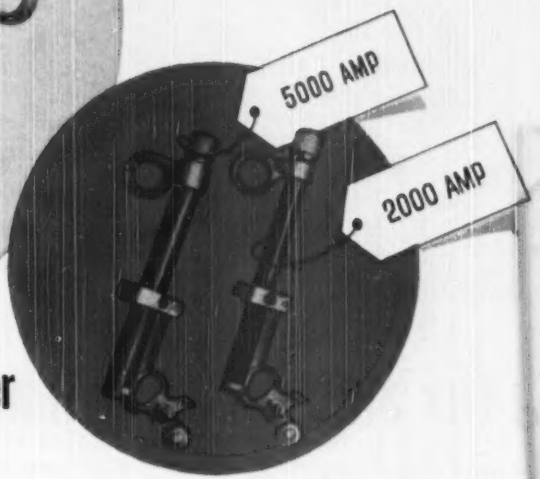


FIG 6—POWER CIRCUIT beyond the capacitors will have a voltage drop as shown. But the line-drop compensator has no way of knowing the capacitors are not at the load center, and will respond to a voltage drop as shown in vector diagram of Fig. 4. Therefore, if capacitors are to be installed in the same substation as the regulator, they should be connected preferably to the source side of the regulator. Then, correct line drop compensation will be obtained



Now! 5000-amp interrupting rating...



simply by changing fuseholder

General Electric 5.2-kv and 7.8-kv open-drop-out cutouts are now available with a 5000-ampere interrupting rating for high-capacity distribution circuits.

This new heavy-duty cutout is identical with the standard cutout (2000 amp interrupting rating) except for the fuseholder. Standard cutouts already in service can be converted to the heavy-duty rating in a matter of seconds—simply by changing the fuseholders. The same fuseholder is used on either 5.2-kv or 7.8-kv cutouts.

G-E ADVANCED DESIGN ALSO GIVES YOU

GREATER ELECTRICAL CLEARANCE—NO UNNECESSARY FUSE BLOWING Electrical clearances are increased by solid porcelain insulator with cemented-in supports instead of troublesome metal clamps. Mounting support is on *opposite side* of porcelain from all live parts, preventing birds and animals from bridging the insulator and blowing fuses.

INSULATOR PROTECTED AGAINST STRESSES DURING RECOIL Because fuseholder is close-coupled to insulator, recoil force of fuseholder is directed along center axis of porcelain, greatly reducing stresses in porcelain. Shock absorbers prevent impact from being transmitted directly to porcelain.

CONTACTS PROTECTED FROM CORROSION Silver-plated contacts are shielded from weather and protected by factory-applied grease which seals out dirt and prevents oxidation. Hinge guides steer fuseholder into upper contacts and prevent contacts from shifting during wind or pole vibration. The same clean areas on the contacts come together each time, keeping contact resistance low and preventing overheating.

Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

Properties of Paper and Glass Insulation

Table lists properties of four kinds of insulation in the forms of sheets and tapes

Adapted from "A Survey of Electrical Insulation Practices" by M. A. Faucett, C. Hoppe and G. E. Leibinger; Circular Series No. 57, published by The Engineering Experiment Station, University of Illinois, Urbana, Ill.

TABLE contains numerical values (light type) wherever possible. A relative value (in bold type) of the property with respect to the other materials is assigned, based on a rating system. Rating of 1 indicates that the material designated is deemed most desirable for the property named. Ratings 1 to 10 are based on opinions reported by industrial users of these materials and should be considered in the light of ratings for other materials listed in a preceding, and a subsequent, installment.

Material	General Remarks	Dielectric Strength, vpm	Thickness, Mils	Abrasion (resistance to)	Flexure (life under)	Creasing (resistance to)	Tear (resistance to)	Handability	Tensile (Breaking) Strength, lb./in. width		Maximum Operating Temperature deg. C	Thermal Aging	Heat Conductivity	Resistance to				
														Moisture	Oil	Acid	Base	Solvent
PAPER SHEETS AND TAPES																		
Condenser	Power Factor 30C 60C 100C Kraft (hot washed) 0.160 0.155 0.225 Kraft (cold washed) 0.160 0.155 0.225		0.475 to 0.525 0.7 to 0.8 0.975 to 0.325 1.9 to 1.1	8	4	6	4	3			105	7	5	8	4	9	9	4
Bond			2.5 to 3.5	2	4	7	3	3	MD 25	CMD 15	105	5	5	8	4	9	9	4
Kraft		400 250 160	0.9 to 1.1 2.8 to 3.2 4.7 to 5.3	9	4	5	4	3	MD 250	CMD 260	105	7	5	8	4	9	9	4
Rope			0.9 to 1.1 1.8 to 2.2 4.5 to 5.5	7	4	4	3	2	MD 10.5 27 70		105	6	5	8	4	9	9	4
Fish Paper		300 300 150	4.0 to 6.0 13.0 to 17.0 116.0 to 134.0	6	4	6	3	3	MD 12 187 1800	CMD 31 93 940	105	7	5	8	4	9	9	4
Rag 100%		460 400 300	6.5 to 7.5 14.0 to 16.0 23.0 to 27.0	4	4	4	3	3	MD 350 800 1250	CMD 500 1400 1600	105	7	5	8	4	9	9	4
GLASS SHEETS AND TAPES																		
Unvarnished Straight		80	1.5 to 15.0	7	2	7	1		wrp. 100 to 400	fil. 70 to 290	300	1	9	1	1	2	4	1
Yellow Varnished, Standard		*	3.0 to 30.0	4	3	9	3				130	4	7	1	1	2	4	1
Yellow Varnished, Bias		*	3.0 to 30.0	4	3	9	3				130	4	7	1	1	2	4	1
Black Varnished, Standard		*	3.0 to 30.0	3	3	8	2				130	3	7	1	2	1	4	3
Black Varnished, Bias		*	3.0 to 30.0	3	3	8	2				130	3	7	1	2	1	4	3
Silicone Varnished, Standard		*	3.0 to 20.0	5	4	9	4		wrp. 70 to 250	fil. 70 to 200	180+	2	7	1	8-10	2	4	8-10
Silicone Varnished, Bias		*	3.0 to 20.0	5	4	9	4		wrp. 70 to 250	fil. 70 to 200	180+	2	7	1	8-10	2	4	8-10

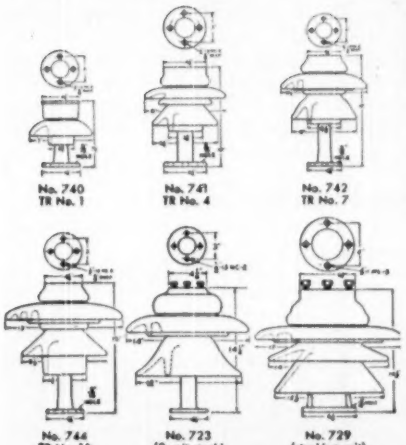
* Dielectric strength varies with over-all thickness and with thickness of varnish film. Values around 1000 vpm are to be expected.

ANOTHER VICTOR INSULATOR THAT SAVES AS IT SERVES

Left: VICTOR switch and bus insulators on a switching structure in the South.

Install VICTOR Switch and Bus Insulators and see how

TROUBLE-FREE PERFORMANCE REALLY PAYS OFF!



No. 740 TR No. 1 — No. 741 TR No. 4 — No. 742 TR No. 7

No. 744 TR No. 10 — No. 723 (2 unit stack) TR No. 16 — No. 729 (stacking unit) TR No. 140

THE number of service-years built into any switch and bus insulator can be determined *only by actual performance data*—data obtained from *all* types of station installations subject to *all* kinds of conditions. And, because of their rugged, heavy-duty construction, that is where VICTOR switch and bus insulators rate *high!* Facts prove VICTOR switch and bus insulators *retain* their original high standards even after many years of severe service. This means *fewer* replacements and *lower* maintenance costs. Find out how much trouble-free performance can *save* you—*standardize* on VICTOR switch and bus insulators.

***Ready now!** A new condensed VICTOR Catalog for handy reference. Write today for your copy.*

Get All the Facts! **CALL YOUR VICTOR REPRESENTATIVE**

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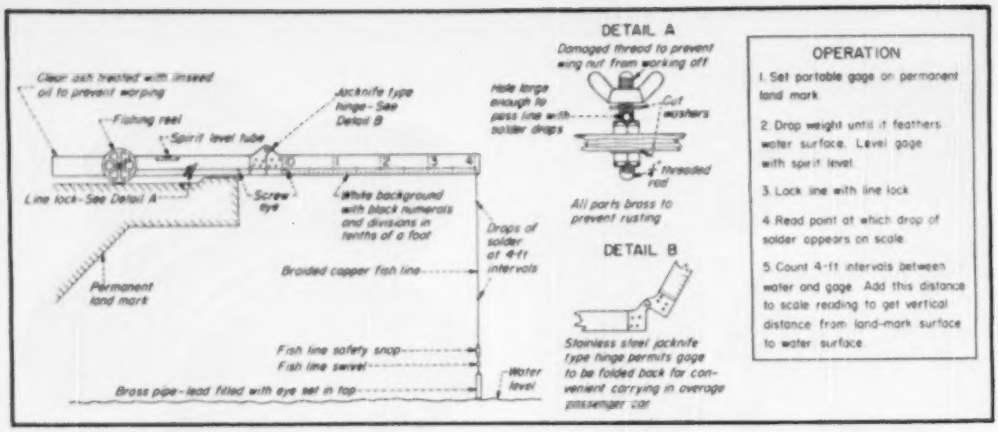
Also distributed nationally by Line Material Company

VICTOR INSULATORS Inc.

VICTOR, NEW YORK

Look for this trade mark of enduring service

V


DETAIL A
Damaged thread to prevent wing nut from working off
Clear ash treated with linseed oil to prevent warping
Jacknife type hinge - See Detail B
Hole large enough to pass line with solder drops
Cut washers
Fishing reel
Spirit level tube
4" threaded rod
Line lock - See Detail A
Screw eye
White background with black numerals and divisions in tenths of a foot
All parts brass to prevent rusting
Drops of solder at 4-ft intervals
DETAIL B
Permanent land mark
Braided copper fish line
Stainless steel jacknife type hinge permits gage to be folded back for convenient carrying in average passenger car
Fish line safety snap
Fish line swivel
Water level
Brass pipe - lead filled with eye set in top
OPERATION
1. Set portable gage on permanent land mark.
2. Drop weight until it feathers water surface. Level gage with spirit level.
3. Lock line with line lock.
4. Read point at which drop of solder appears on scale.
5. Count 4-ft intervals between water and gage. Add this distance to scale reading to get vertical distance from land-mark surface to water surface.

PORTABLE RIVER GAGE may be operated by one man to determine height of water in rivers. Gage can be supported from any permanent landmark along river bank, such as a rock, bridge abutment, or in extreme cases, a spike driven into a suitable tree. Points from which readings have been taken can be levelled to establish bench marks if desirable. Gage folds to half-length for carrying

Determine River Level with Portable Gage

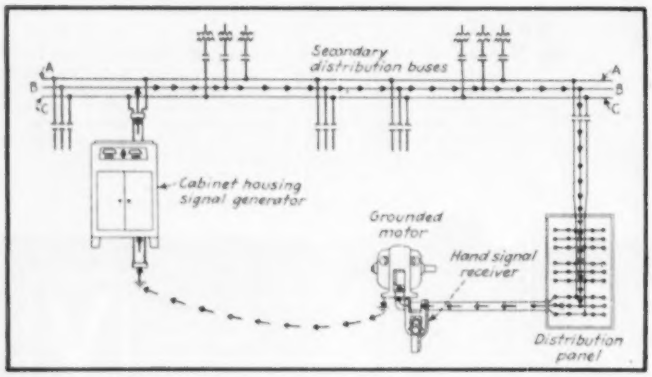
ROBERT W. BURTON
New England Power Co
Shelburne Falls, Mass.

HEIGHT OF WATER in rivers can be determined accurately at regular or intermittent intervals using the portable gage illustrated. This gage can be operated by one man and is designed to fold to a half-length of 4.5 ft for convenient storage in the trunk or rear seat of an automobile.

In operation the gage is placed horizontally on a permanent landmark, and a weight is let down from the end of the scale to the water surface. When the weight just feathers the water surface, the distance represented by solder drops at 4-ft intervals on the copper fish line, plus the reading of the solder drop against the scale, is the vertical distance from the bottom of the gage to the water surface. For example, with one solder drop below the gage and the next showing against the scale opposite the 1-ft graduation, the total distance between the scale bottom and the water surface is 5 ft.

Vertical distances up to 24 ft have been read without difficulty. No noticeable sag or warping has developed in the wood members during several years' service. Copper braided fish line is used because it does not appear to stretch appreciably. A metal clip is provided on the back of the gage to hold the weight when the gage is not in use.

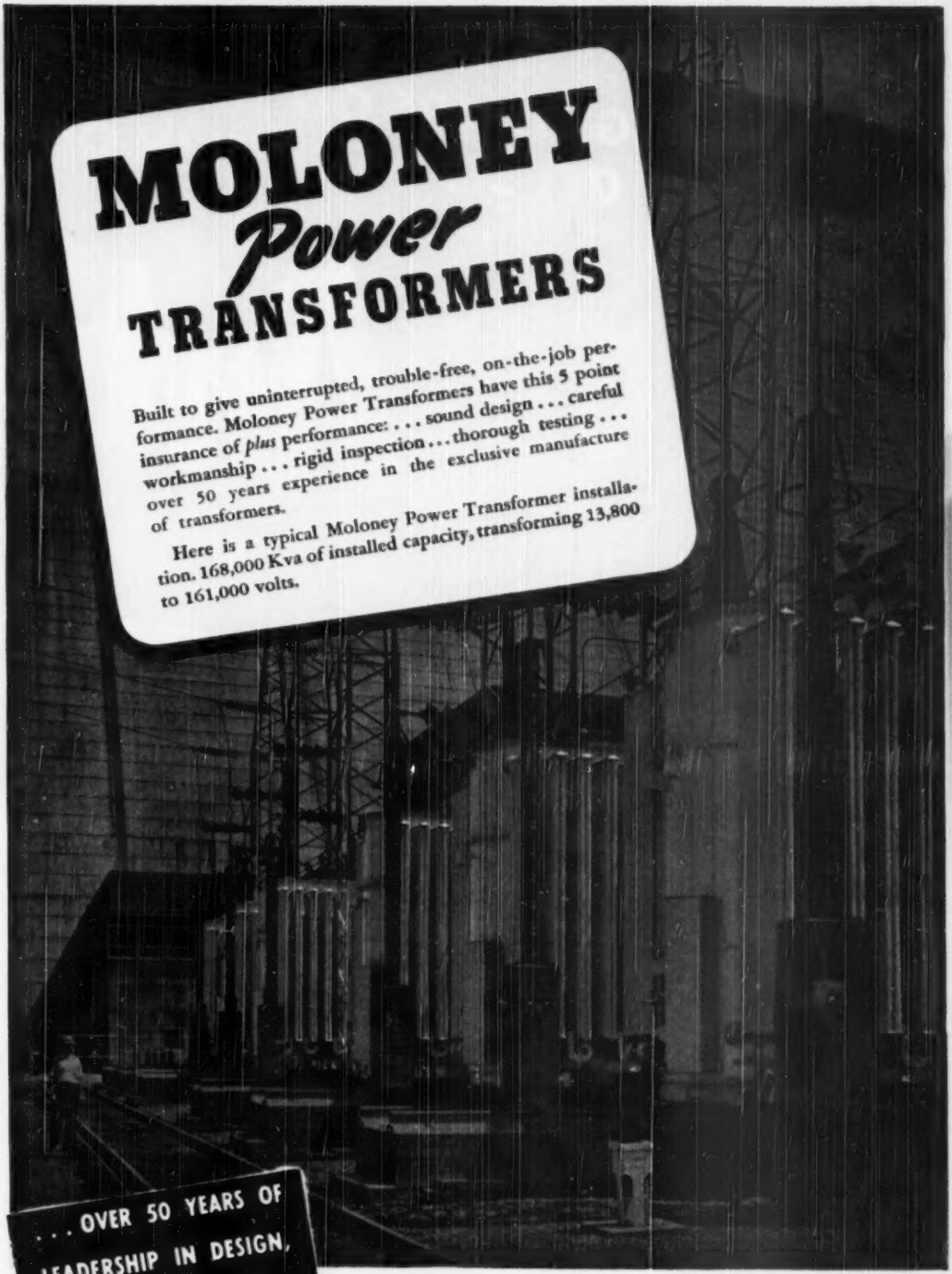
Ground Detector Cuts Maintenance Costs



GROUNDED CIRCUIT (arrows) carries pulsating signal current generated by signal generator. Hand signal receiver picks up signal along grounded circuit and gives pulsating meter indication until point of fault is passed. Needle then remains stationary

SAVINGS ESTIMATED at $15,000 per year have been effected at the Chicago tractor works of International Harvester Co by means of a ground detecting apparatus which can be used on energized lines with electrical equipment in operation. Use of the apparatus, known as the Allen Ground Detector, saves time in locating electrical grounds, with corresponding reduction in equipment repairs, and elimination of production stoppages due to de-energizing grounded lines to prevent damage.

Grounds can be located in minutes with this apparatus, whereas in the former method it was necessary to shut down circuits one by one until the grounded circuit was found, and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Power
TRANSFORMERS
Built to give uninterrupted, trouble-free, on-the-job performance. Moloney Power Transformers have this 5 point insurance of *plus* performance: . . . sound design . . . careful workmanship . . . rigid inspection . . . thorough testing . . . over 50 years experience in the exclusive manufacture of transformers.
Here is a typical Moloney Power Transformer installation. 168,000 Kva of installed capacity, transforming 13,800 to 161,000 volts.
. . . OVER 50 YEARS OF LEADERSHIP IN DESIGN, RESEARCH, ENGINEERING

MOLONEY ELECTRIC CO. ★ ST. LOUIS 20, MO.

POWER AND DISTRIBUTION TRANSFORMERS EXCLUSIVELY SINCE 1894

LONGER NIGHTS ARE ON THE WAY... GET SET TO CASH IN ON

Anti-

A great new advertising campaign...

Here's your biggest chance of the year for extra lamp sales. General Electric's fall Anti-Bulbsnatching Drive. It's featured in advertising that your average customer will see, hear and read over and over between September 18 and November 4. The Fred Waring Television Show. Spot radio. Leading magazines like the Post, Life, Look. Sunday newspaper supplements. And it's all timed for the peak of the lamp-buying season, when longer nights are on the way!

LAMPS

Feature these fall lamp values!

100 WATT WHITE LAMP

100-200-300 WATT LAMP

NEW 30-GA LAMP

G-E 4 LAMP PACKAGE

GENERAL ELECTRIC'S

Bulbsnatching Drive!

STARTS SEPT. 18

promoting the greatest lamp-selling idea...

You'll cash in on the greatest lamp-selling theme ever created—*bulbsnatching*—General Electric's popular name for robbing one light socket to fill another. It's a phrase that hits home with everyone—brings more sales to every G-E lamp agent!

backed by a complete display package!

G-E lamp agents will get colorful counter cards, streamer, carton tuck-ins, price cards and a full sheet of display suggestions. Be sure you tie in! You're bound to boost your lamp sales this fall!

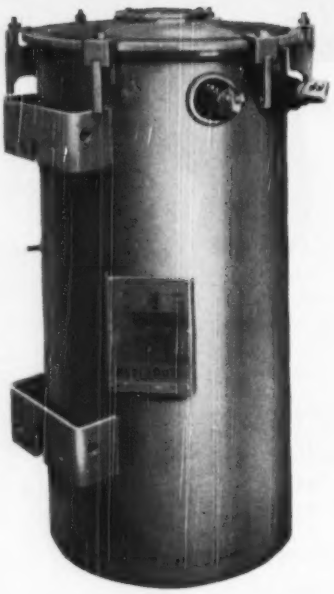
GENERAL ELECTRIC

Lamp manufacturers have spent years in research to provide good street lighting lamps that will give hundreds of hours of brilliant illumination.

Why spoil these good lamps with high inrush currents.

Hevi Duty Static Type Constant Current Regulators are designed to eliminate the conditions that shorten the useful life of a good lamp.

Write for bulletin CCR478



HEVI DUTY ELECTRIC COMPANY

MEAT TREATING FURNACES **HEVI-DUTY** ELECTRIC EXCLUSIVELY

DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS

MILWAUKEE 1, WISCONSIN

SIGNAL RECEIVER, when moved along distribution panel, indicates grounded branch circuit until fault is passed

then laboriously locate the actual ground—a chore which might take hours, or even days, for a team of electricians to accomplish. In the case of one ground occurring at the tractor works, point of ground fault, which was several hundred feet from the main switchboard room where the apparatus was installed, was detected and located within 12 min after it had taken place.

The new apparatus, developed by electrician C. D. Allen, consists of a signal generator and a hand signal receiver similar to the clamp-on ammeter. The signal generator superimposes a low-voltage alternating (50 times per min) signal current on the grounded phase conductor. This signal current (22 amp max) flows through the grounded conductor to point of ground fault and then back to the signal generator through ground. Actual fault point is traced and located by passing the supersensitive hand receiver along feeders, distribution cabinets and branch circuits known to be grounded. A microammeter in the receiver picks up the signal current and gives a pulsating indication until the fault is reached. At the point of fault, where the signal current returns to the generator through ground, the needle remains stationary.

Grounded phase is first detected by a voltmeter and phase selector switch on the signal generator control panel. Other accessories include a meter to register signal current; a test button to indicate ground intensity; an "Off-Automatic" switch to control the automatic impulse signal; and a pilot light. Control circuit for the automatic signal generator operates on 115 v, 1-ph, 60 cycles. Signal generator is permanently installed through a 30-amp, fusible switch adjacent to main switchboard in plant substation.

HI-TENSION NEWS *Junior*

Why Cut Power Conductors at Every Strain Point?

Jumper loops at strain points are actually easier and cheaper to build *without cutting*. Added to this is complete freedom from bolted splices that are a recognized source of serious operating trouble.

By the use of O-B Hi-Lite malleable iron or Cooline non-magnetic strain clamps, conductor is conveniently strung through strain points and the jumper becomes a part of the continuous power cable -- minus any splices and minus any future hazard. The secure snubbed and bolted grip of these clamps develops full operating strength of the cable. It is easy to inspect for soundness at the time of installation and just as easy to check during later periods of line maintenance.

Taken from any standpoint -- security, freedom from trouble, convenience, cost -- the continuous jumper made up with O-B strain clamps should be standard on your future line construction projects.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS *Junior*

TWO IMPORTANT WORDS

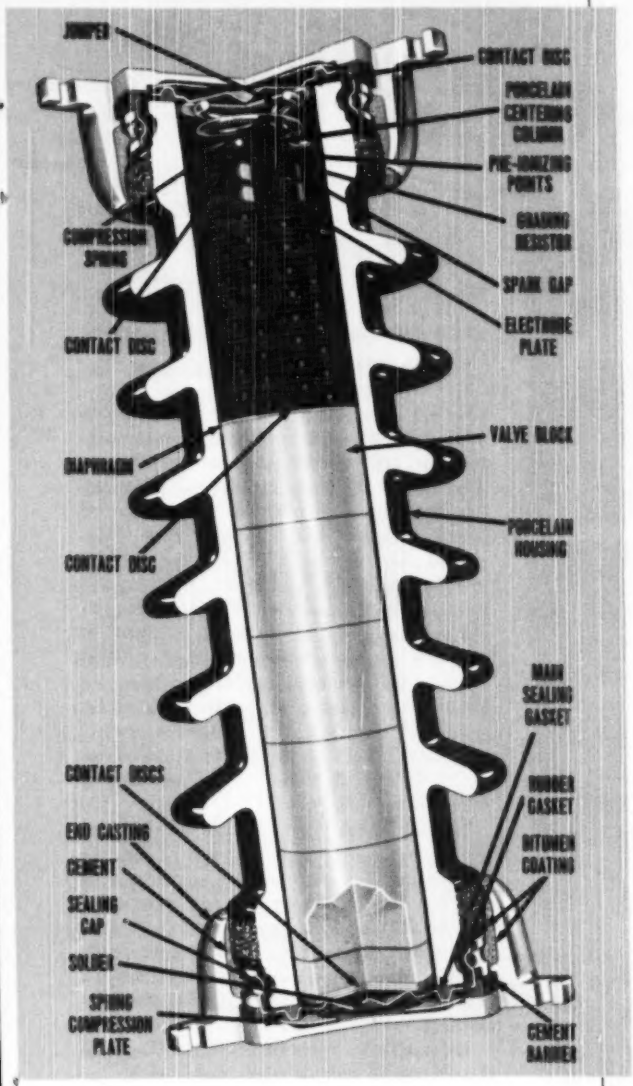
"LESS THAN + 5% IR DISCHARGE TOLERANCE" IN NEW O-B THOREX ARRESTER

It is well to consider just what is back of the statement, "Less than +5% IR discharge voltage tolerance" in the new O-B Thorex valve type lightning arrester. Typical of any mass-produced item, production latitude is allowed but, in the case of the Thorex, variations must fall within the +5% limit. Each arrester is tested to assure this low over-all tolerance in total factory output, and in order to meet such a standard, it is obvious that individual specimens must remain below the permissible maximum.

Plus 5% IR discharge voltage tolerance as a cataloged value is new on the American arrester market and, when we remember the Thorex is a factory-made product, mass production methods require better than 5%. Hence the important two words *"Less than +5%."* This unusually close tolerance is combined with extremely low average IR discharge. Of further importance is the fact that such performance is offered in a standard, non-premium arrester possessing all heavy-duty ratings.

As station protection experts realize, this close operating tolerance of the O-B Thorex permits lower insulation levels in apparatus--a practice that is rapidly gaining favor because of the major economies it offers.

Discuss the new Thorex valve type lightning arrester with your O-B representative or write for the complete descriptive publication Number 869-H, recently released, so that you may promptly consider Thorex protection.



Quick Facts

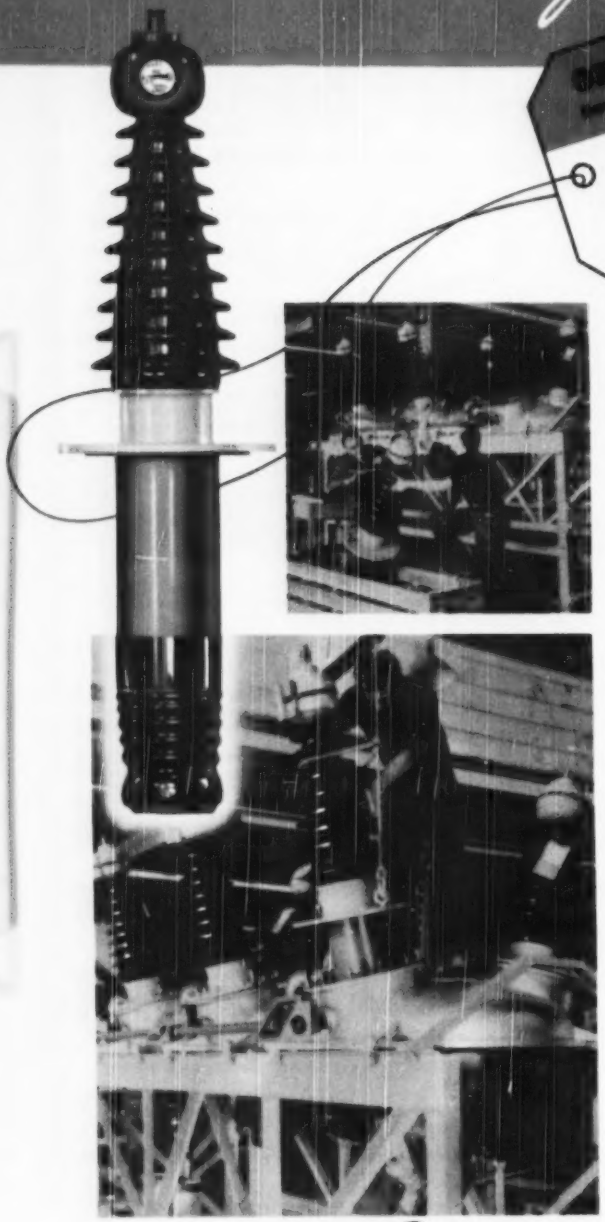
ABOUT THE O-B THOREX VALVE TYPE LIGHTNING ARRESTER

- Low IR discharge voltage--+5 per cent tolerance.
- High speed, low sparkover series gap--+10 percent tolerance.
- High thermal capacity; meets Standard requirement for 100,000-ampere discharge.
- Meets Standard 10,000-ampere operating duty cycle test.
- Specially prepared silicon carbide block material with inorganic, high-temperature-produced bond results in excellent IR discharge performance.
- Exceptional interrupting ability of series gap for power follow current.
- Simple, compact series gap design.
- Dry, inert gas-filled.
- Multiple sealed.
- Primary seal provided with constant follow-up pressure.
- O-B wet ware electrical porcelain protective casing.
- Meets Standard insulation withstand voltage test for 100,000-ampere lightning arresters.
- May be cap suspended or upright mounted on foundation, structures, or apparatus casing.
- High pressure solderless terminals.
- Either base or cap may be connected to line or ground.
- Short, small diameter, light weight.
- Nine interchangeable units, making multiplicity of applications from 2.4 to 138 kv.
- For indoor or outdoor application.
- Sturdy, galvanized malleable iron end fittings.
- Simple three-bolt mounting base.
- Variety of mounting accessories available.
- Developed by leading Swedish electrical manufacturer.
- Over 40,000 units in service for periods up to 12 years.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS *Junior*



O-B Bushings

ONE OF THE FINEST COMPONENTS OF ANY CIRCUIT BREAKER

Respect for the high value of a bushing is well demonstrated by a comment recently received from an official of Pacific Electric Manufacturing Corporation: "The insulating bushing is such an important part of a high voltage circuit breaker that it deserves only the best of handling on the erection floor. Our practice is to bring the bushing, in its unopened factory crate, directly alongside the circuit breaker in which it is to be installed. By use of a special rigging, an overhead crane then lifts the bushing and lowers it gently into place, guided by two skilled men. All factory inspection tags are left on the bushings so the user will receive them exactly as shipped from the manufacturer."

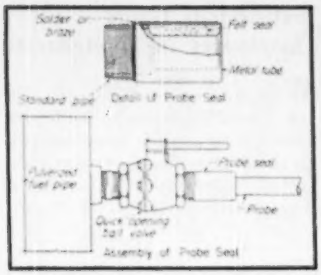
It is significant that an apparatus builder who makes such a definite point of the importance of bushings on his equipment is likewise one of the largest and most consistent O-B bushing users. And it is perfectly obvious that, while bushings don't make the equipment, a piece of apparatus is no better than the bushings put there to serve it.

This attitude of an independent, capable manufacturer may suggest the wisdom of specifying O-B bushings on your own station equipment.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

3045-H



PROBE SEAL lined with felt prevents outward flow of pulverized coal around probe during the sampling period

Probe Seal Prevents Pulverized Coal Leakage

O. C. SWIHART
Results Tester
Twin Branch Plant
Indiana & Michigan Electric Co
South Bend, Indiana

A SELF-SEALING probe-seal for obtaining samples from the pulverized-coal system at Twin Branch Plant reduces the sampling time and permits operators to obtain better samples. Sampling facilities shown in the accompanying illustration were developed to conform with the recent redesign of sampling openings on the pulverized-fuel lines to Unit 5.

These advantages have been observed:

1. Elimination of approximately $1,500 initial cost of the old air-jet seal-type sampling openings.

2. Elimination of compressed-air requirements.

3. Reduction of sampling time from 2 hr to 20 min, thereby saving an estimated $1,000 in one year.

4. More accurate samples because of elimination of air-fuel flow disturbances at the tip of the sampling probe caused by compressed air.

During initial operation of Unit 5, extreme difficulty was experienced in preventing leakage of pulverized coal around the initial sampling probe. Consequently, the air-jet type of seal was replaced by a quick-opening ball-type valve due to economy of decreased material, operating, and maintenance costs. The sampling probe is properly sealed during its insertion into the pulverized-coal line by a felt-lined seal. The probe is inserted into the seal far enough to prevent escape of pulverized coal when the valve is opened. The sample is obtained in the routine manner.

GOOD EQUIPMENT
CAN MEAN THE DIFFERENCE
when BARTLETT does
your
LINE CLEARANCE
YOU know the difference in time and efficiency good equipment makes. It's just one more reason why so many utility companies rely on Bartlett. More equipment and better equipment . . . up-to-date and maintained in top condition. This assures speed and clean work that reflects to your credit. The name Bartlett means the best in tree work . . . and your customers know it.
YOU receive plus value when you retain Bartlett. Play safe; your name and prestige is at stake, too. Call our local office in your community or write direct for our nearest representative to call.
BARTLETT SERVICE MEANS
• CLOSE SUPERVISION
• TRAINED MEN
• BEST EQUIPMENT
• CAREFUL WORK
• PROMPT SERVICE
• ECONOMY
• RESPONSIBILITY
BARTLETT
TREE EXPERTS
The Bartlett Way
HOME OFFICE: RESEARCH LABORATORIES & EXPERIMENTAL GROUNDS, STAMFORD, CONN.
LOCAL OFFICES: Rutland, Windsor, Vt.; Milford, Peterboro, Rochester, N. H.; Cambridge, Framingham, Manchester, Osterville, Pittsfield, Mass.; Providence, R. I.; Danbury, Hartford, New Canaan, New Haven, Stamford, Westport, Conn.; Islip, Kingston, Monroe, Middletown, New York, Peekskill, Southampton, Syracuse, Westbury, White Plains, N. Y.; Barnardsville, Morristown, Orange, N. J.; Chambersburg, Paoli, Philadelphia (Cynwyd), York, Pa.; Wilmington, Del.; Bethesda, Easton, Towson, Md.; Ashland, Ky.; Lancaster, Portsmouth, Ohio; Charlottesville, Lynchburg, Roanoke, Va.; Bluefield, Charleston, Huntington, W. Va.; Kingsport, Tenn.

Write for Your Copy TODAY

THAT is the ANDERSON BRASS MERCUROUS NITRATE TEST. It essentially is a "GO, NO-GO" test and INSURES AGAINST copper base EYEBOLT CONNECTOR FAILURES DUE TO:

SEASONAL CRACKING
STRESS CORROSION

particularly WHEN FAULT CURRENT SURGES AND STRESSES OCCUR. AS A RESULT, more and more electric UTILITIES AND equipment MANFACTURERS ARE WRITING MERCUROUS NITRATE PERFORMANCE IN THEIR SPECIFICATIONS.

We are happy to support this movement and will do our part by furnishing copies of Anderson Brass Mercurous Nitrate Specifications to all interested engineers upon request.

ANDERSON BRASS EYEBOLT CONNECTORS WITHSTAND 15 minute IMMERSION IN MERCUROUS NITRATE, while assembled and stressed to service conditions. This is more severe than ASTM-B154-45*. So far as we have been able to ascertain, IT IS THE MOST RIGID EYEBOLT CONNECTOR TEST KNOWN.

BE SURE OF PERFORMANCE
SPECIFY CONNECTORS THAT PASS ALL TESTS

*Mercurous Nitrate Test with Identical Immersion Time but with Unstressed components.

AND NOW READ ONLY WORDS IN RED!

ANDERSON BRASS WORKS, Inc.
POST OFFICE DRAWER 2151
BIRMINGHAM, 1, ALABAMA

• BRONZE AND ALUMINUM POWER CONNECTORS, FITTINGS, AND BUS SUPPORTS
ALUMINUM SUSPENSION AND STRAIN CLAMPS

Instructions Guide Employees in Emergencies

WHETHER on or off the job, you may meet emergency conditions where life or property is endangered. To guide its workers in emergencies, Central Maine Power Co has issued these instructions to all of its employees:

EMERGENCY CONDITIONS
(When Life or Property is Endangered)

Every employee, no matter what his job, should know what to do when he meets emergency conditions on or off the job.

If you encounter conditions involving live circuits—

- Keep everyone clear of the circuits.
- If properly qualified, kill the circuit.
- If not, have someone stand by to warn pedestrians and vehicles. Contact the local office to have the circuit killed.
- Don't leave until relieved by qualified employees.
- If the line is a high tension line and you are qualified, open only those switches necessary to clear the trouble. Call the load dispatcher at once, giving all details involving the accident.
- If not qualified to operate switches, call the dispatcher or nearest substation to have the circuit killed.

If you receive an emergency report by phone, ask these questions—

- What is the *exact* location?
- Is human life in danger?
  If so, take down the phone number and ask the person calling to remain where he is, as you will call back. Contact either the local office or the dispatcher and have the circuit killed at once. Report back to the caller and tell him what you have done.
- What is the nature of the trouble?
- Who is the person calling?
- Where is he calling from?

Loose Hinge Pins May Cause Operating Trouble

Loose hinge pins of hinged-cover meters may result in damage and serious operating trouble. In one case, a recording voltmeter cover came off and fell on a bus differential tripping relay in a distribution substation, causing an outage of about 3 min.

Now all loose pins are replaced with cotter pins of the same diameter to assure a dust-tight cover. Spread ends are turned inward to prevent anyone being scratched.

Cut Cost

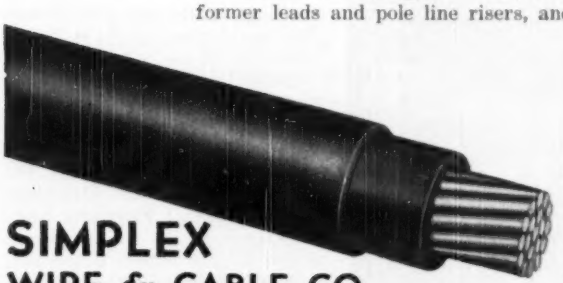
...IN THE PLANNING STAGE--

Specify SIMPLEX-ANHYDROPRENE CABLES

When planning transmission and distribution systems for installation in conduit, in underground ducts, or in open air raceways in buildings, you'll take a big step toward low-cost operation by specifying Simplex-Anhydroprene Cables. . . . Their simple construction, stable electrical and physical properties, and versatility provide many advantages profitably realized in low purchase cost, low installation and maintenance costs and long service life. . . . Some of these cost-cutters are included in the checklist below. But even they are only a few of many available to you when you install Anhydroprene Cables. For the complete Anhydroprene story, plus specification data, drop us a card today for Bulletin 115. (Fill out and mail the coupon below.)

- Light Weight
- Small Diameter
- No Braids to Rot
- Flexibility at Low Temperatures
- Abrasion Resistance
- Low Water Absorption
- Protection against Oils, Heat, Sunlight and Flame
- Resistance to Acids, Alkalies and Corrosive Chemicals
- Easy Jointing and Tapping
- Elimination of Duct Lubricants
- No Potheads Needed at Terminations

Simplex-Anhydroprene Cables are recommended for plant and shop wiring, for instrument wiring, for use as underground primaries and secondaries, transformer leads and pole line risers, and in signal and control circuits.



SIMPLEX
WIRE & CABLE CO.
79 Sidney St., Cambridge 39, Mass.

SIMPLEX WIRE & CABLE CO.
79 SIDNEY ST., CAMBRIDGE 39, MASS.
GENTLEMEN: PLEASE SEND BULLETIN 115 TO
NAME _____ TITLE _____
FIRM _____
STREET _____
CITY _____ STATE _____

LOAD BUILDING

RESIDENTIAL • RURAL
COMMERCIAL • INDUSTRIAL

COOK BADGES were earned by girl scouts through program put on in All Electric kitchen

Girl Scouts Learn Electric Cooking

GIRL SCOUTS in Ft. Wayne (Ind.) have been earning their "Cook" badges by cooking on electric ranges, at classes conducted by Indiana and Michigan Electric Company's home economist. The classes, four for each group, were held in the company's "Leisure Electric Home" in the downtown office building in Ft. Wayne.

Groups number approximately 30 each and classes are scheduled in cooperation with girl scout leaders who were most enthusiastic over the opportunity of having expert assistance in their scout program.

Ten activities were selected from the group listed in the *Girl Scout Handbook for the Cook Badge.* Selection was made to give a variety that would result in teaching the girls to use the oven, deepwell, broiler and surface units. Classes were planned for 1½-hr periods and school authorities cooperated by allowing girls to leave school a little early where necessary in order to be on time for the cooking classes.

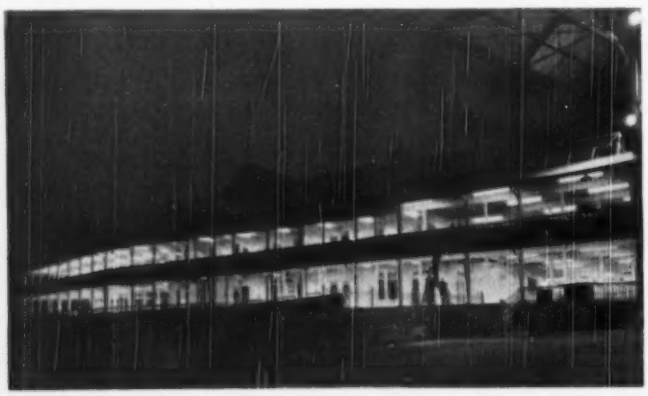
Taking the ten activities from the *Girl Scout Handbook* as a theme, the company's home economists developed a four-lesson program, "Easy Does It" and prepared a handbook on work to be accomplished, some of which was planned for the "Leisure Electric Home" and some to be done in the homes of the girls.

At the last meeting the girls brought their mothers for tea. They were given an opportunity to show their mothers the equipment in the "Leisure Electric Home" and demonstrate how it operated. The girls proved to be good sales people.

Also at the last meeting each girl was awarded her Cook badge and presented a Reddy Apron.

There were 1,091 girls and their mothers who participated in this program. Scout leaders, girls and mothers are most enthusiastic about the activity. Following the first meetings, troops that had not been included rushed to arrange a schedule for their participation. Both the girls and their mothers have brought friends to the "Leisure Electric Home".

• • •



CLUB HOUSE at Yonkers Raceway as well as the grandstand and other off-track premises are illuminated by cold cathode type of fluorescent lamps

Cold Cathode Lights Racetrack Club House

AMONG THE renovations and innovations to enhance the Yonkers Raceway, Yonkers, N. Y., is the extensive use of cold cathode lamps.

Except for the illumination of the racing strip itself (ELECTRICAL WORLD, July 31, 1950, p 106), all the premises, club house, grandstand, general offices, mutuel windows, and calculating rooms are illuminated with this type of fluorescent lamp.

At this emporium of trotting races, a total of 1,500 fixtures is involved, each 8 ft long, using approximately 38,000 ft of lamps. If the fixtures were placed end to end, they would

Your Company may be Using or Planning

a Sales Idea

that could win a prize in the

1950 Hughes Award Competition

The Hughes Awards for 1950 will be based on productive sales *ideas* regardless of the size of the company or conditions in the territory served. The winners will be individuals and companies submitting successful methods, new or old, which have proved effective in solving a major appliance merchandising problem in the area they serve. Elaborately prepared entries will have no advantage over simple, documented case-histories of successful sales programs.

Arrange now to enter the promotion plan or sales campaign that helped your Company bring some worthwhile electric appliance into the homes of your area.

1950 Hughes Award Booklets are now ready for distribution—write Edison Electric Institute, 420 Lexington Avenue, New York City 17, N. Y.

Utility Division

Hotpoint Inc.

(A General Electric Affiliate)

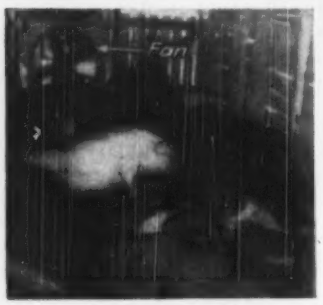
5600 West Taylor Street, Chicago 44, Illinois

illuminate a strip about 2.5 miles long.

The off-track illumination gives a soft balmy light. The lamps are color corrected, making their light complimentary to the human complexion and imparting a natural look to colored objects and materials.

Power is supplied by Yonkers Electric Light & Power Co through a 13/4 kv substation and a 500-kva 4-kv/125-v air-cooled transformer.

•



ATTIC FAN and wetted layer of sand on the floor lowers temperature by 15 deg

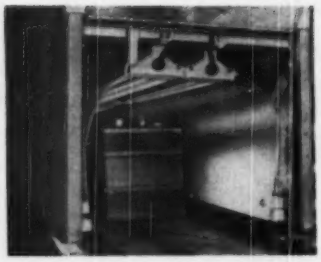
Attic Fan for Air-Cooled Pork On the Hoof

It's air-cooled pork on the hoof at the T. R. Pender farm at Williston, S. C., since installation of an attic fan in the large pig shed. This use of electricity on the farm was suggested last summer by Comer J. Renfroe, manager of the rural division of South Carolina Electric & Gas Co, Charleston.

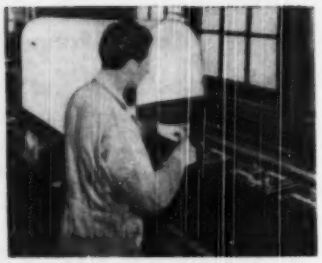
With 80 of his 200 hogs being specially fed on a record test, Mr. Pender found that the hogs were not gaining the expected daily weight. This was attributed to the hot weather which kept the hogs from consuming normal portions of food.

To correct the situation, a 36-in. attic fan, operated by a ¼-hp motor, was installed in one end of the hog shed. A 4-in. layer of builders' sand was spread on the floor and sprinkled with water two or three times a day. Air blowing over the wet sand increased humidity and lowered the inside temperature of the pen by 15 deg.

Records show that the hogs added weight by about one pound a day during July, and two pounds daily during August and September.



RADIANT INFRARED oven flows asphalt compound for sealing storage battery cells without damage previously experienced by gas flame method



Edwin L. Wiegand Co photos

CONVEYOR moves battery cases through 6-ft long oven at 5 fpm. Four 1,100-w, 230-v heaters are used 8 to 16 hr per day. Batteries move along 1½ in. to 2 in. beneath heaters

Infrared Speeds Battery Production

POWER SALES IN INDUSTRY

Four radiant infrared heaters are used in an oven at the National Battery Co, St. Paul, Minn., to flow the asphalt compound used for sealing the cells in storage batteries. These heaters replaced a gas flame which burned the top of the batteries and failed to produce the proper knit of asphalt compound and case.

The infrared heaters properly knit the asphalt without any detrimental effects on the batteries; they increase production with fewer rejects; they operate in high ambient temperatures permitting higher efficiency; they have a greatly simplified control and fire hazard is reduced due to elimination of gas. Total cost of this installation was less than any equivalent heating means and it has been recommended for installation in all plants of this company.

Heaters are installed in oven so that batteries pass under them on a conveyor at a distance of 1½ to 2 in. They are 1,100-w, 230-v each, and are controlled by thermostat and interlocked with conveyor motor so that heater circuit opens whenever conveyor stops.

One rheostat controls each group of two heaters—providing maximum flexibility of temperature in each end of the oven. Temperature of 525 F is considered proper for bonding without burning cases. Rheostat control provides flexibility of control for several different sizes of storage batteries which pass under heater during the bonding process.

Heaters are in use 8 to 16 hr per day. Conveyor speed is approximately 5 ft per min. Tunnel oven is 6 ft long.

Load Building Notes

● Effects of high frequency sound radiation on hybrid seed corn are being studied at the U. S. Department of Agriculture Research Center at Beltsville, Maryland. Using a high-intensity ultrasonic generator, government agronomists are trying to evaluate the effects of time and intensity of treatment on germination, flowering, growth and yield. Based on previous experiments with other seeds they expect a faster germination, but also possible failure of some of the seeds to take root. The end object of the research, of course, is higher production.

● Average residential consumption of electricity in Illinois in the first quarter of 1950 was 462 kwhr as against 430 kwhr for the same 1949 period, according to the Illinois Commerce Commission. In rural service the respective figures were 1,000 and 892 kwhr; in small light and power, 2,040 and 1,930 kwhr. In contrast with these increases is a decrease in first-quarter use of energy by the average large light and power customer, from 252,000 kwhr in 1949 to 243,500 in 1950. This caused the average for all consumers to remain almost unchanged from the 1,770 kwhr of 1949.

durasheath

the all-purpose cable

Durasheath Is Versatile . . . It's Underwriters' approved for 600 volt underground services . . . Use it in power and lighting circuits, industrial plants, mines, airports, housing developments and farms — wherever your power distribution calls for cable . . . large or small . . . in one, two or three conductors . . . from 600 to 8,000 volts.

Durasheath Is Safe, Dependable and Economical . . . Durasheath* resists corrosion and extremes in temperatures. Its tough Neoprene jacket eliminates electrolysis and resists oil, flame, abrasion, cutting, impact . . . as well as moisture, acids and alkalies in the soil. It is lightweight and flexible—reduces installation costs.

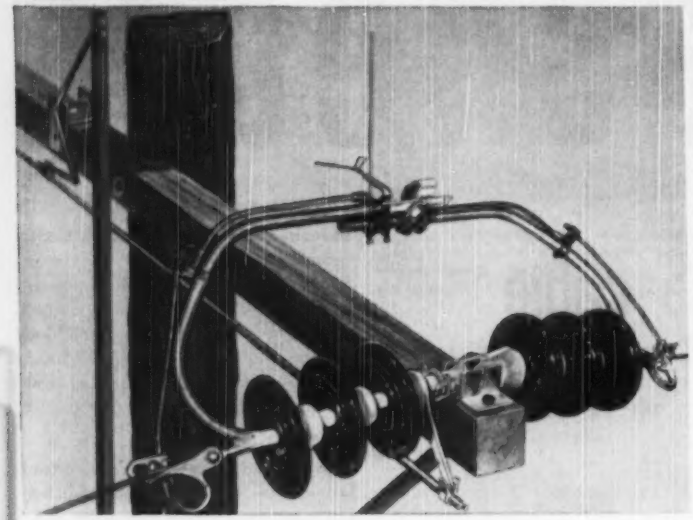
You can use Durasheath—overhead . . . down a building . . . and in the ground—in one continuous run.

LEARN THE FULL DETAILS of how and why Durasheath can do a more efficient, safer power distribution job . . . and at lower costs! Contact your nearest Anaconda Sales Office or Distributor today. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Reg. U. S. Pat. Off.

the right cable for the job **ANACONDA®**
WIRE AND CABLE

KPF POLE TOP SWITCHES



Simple design means more switch ...for less money!

KPF Pole Top Switches cost less because they are simplest in design. They lower installation costs because they bolt on a single crossarm in minutes, require no extra insulators. KPF switches save, too, on upkeep; simple push-pull interphase rods never bind because of crossarm warpage; monel and bronze bearings never need lubrication.

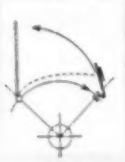
KPF switches may be used in horizontal, vertical or triangular mounting. Free floating, self aligning blades and jaws maintain proper contact under all conditions of switch sag adjustment.

NEW QUICK-BREAK ATTACHMENT FOR KPF SWITCHES

The split-second breaking speed of these new KPF attachments means you can switch many circuits without using expensive circuit breakers. Attachment is available for all KPF switches rated 15 to 69 kv.

WRITE FOR DETAILS

Spring rod winds to full tension as switch opens.



Rod springs clear, breaking contact at high speed.

KPF ELECTRIC COMPANY
855 Howard Street • San Francisco 3, Calif.

INDUSTRIAL BRIEFS

Immersion Heaters cast in four 2,000-lb capacity melting pots increased production 25% at Reading Batteries, Inc, Reading, Pa. Electric heaters were installed four years ago and have completed 125,000 hr of continuous operation without maintenance, no down time and close temperature control. Cost of power consumed by heaters is less than maintenance cost alone of previously used coal stokers. Melting pots are used to melt pigs of lead for battery parts. Working conditions have greatly improved because of low radiant heat loss of electric heating units.

Disconnecting Hangers for high bay double prismatic reflector (mercury vapor and incandescent) lighting units at the Studebaker Corp, South Bend, Ind., plant save time and labor and reduce hazards. They permit cleaning and relamping units from floor level. One service man can handle job with both hands free for quick, efficient work. Since hangers automatically disconnect lighting fixtures from electrical circuit when they are unlatched for lowering, electrical hazard is eliminated. No climbing or ladders being required, these hazards, and possibility of tools or materials falling from overhead, are also eliminated.

Load-Center Unit Substations save time and money at the Maytag Co, Newton, Iowa. Space is saved by locating units on platforms under the roof, right over the load area. According to L. C. McAnly, Sr, Maytag's Manager of Manufacturing, this type of power distribution system assures continuous power for their manufacturing facilities and they can easily expand it to take care of any increase in operations. These units were operating in a very short time.

Midget Heaters keep plastic mixing chambers and dies at exactly the right temperature for perfect extrusion at the Carter Products Co, Cleveland, Ohio. Thousands of feet of plastic pipe are extruded daily with virtually no rejects, according to Rudolph Kustra, plant superintendent.—Industrial Heating Div, Cleveland Electric Illuminating Co.

When you think of Electric Heat...

think of Hoskins Chromel*

One quick glance at your industrial heating load will tell you that electric furnaces account for a good and growing part of your total power sales. They represent a highly promotable load potential, too. Because they're safer, cleaner, easier to work with than fuel-fired equipment. They improve working conditions, assure greater productivity, produce better results. They provide more uniform distribution of heat, permit closer control of temperatures, offer greater flexibility of operation. And in addition, too, they give unusually dependable performance over long, hard periods of use thanks to the extreme durability of HOSKINS CHROMEL heating element alloy.

CHROMEL, you know, is the *original* nickel-chromium resistance alloy that *first* made electrical heating practical. It's highly resistant to oxidation because, in use, it forms a thin, dense oxide "skin" which acts as tight, protective armor against further deterioration. It possesses close-to-constant "hot" resistance between 700° and 2000°F., delivers full-rated power throughout its long and useful life. And, backed by over 40 years specialized research, manufacturing and application experience, CHROMEL has been used consistently and with confidence by nearly every manufacturer of industrial, commercial and household electrical heating devices.

So where you're called in on an electrical heating application, you'll do well to recommend the use of HOSKINS CHROMEL heating element alloy. It's your best assurance of giving your customers the continuity of service they want.

Our Catalog M-1 contains useful technical information and helpful application data . . . want a copy?

HOSKINS MANUFACTURING COMPANY

4445 LAWTON AVE. • DETROIT 8, MICHIGAN

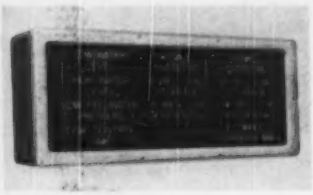
NEW YORK • CLEVELAND • CHICAGO

West Coast Representatives in Seattle, San Francisco, Los Angeles

In Canada: Walker Metal Products, Ltd., Walkerville, Ontario

**the original nickel-chromium resistance alloy that first made electrical heating practical*

NEW EQUIPMENT



Annunciator

DESIGNED for readability at a distance of 60 ft, Type ANJ annunciator utilizes 2¾x9¾ in. window areas with lettering on a heavy photographic negative held between glass sheets.

The instrument is for surface or flush mounting. It may be used to supervise liquid levels, electro-mechanical movements (such as circuit breakers, motor starters, etc), temperatures, pressures or vacuums, rotary movements, presence or absence of light (pilot flame), etc.

Standard circuit of the annunciator is said to provide facilities for simultaneously testing all lamps, relays, and inter-connecting circuits; silencing the remote audible alarm with a common silencing switch; and resetting the relays with a common reset switch.

The Autocall Co, Shelby, Ohio

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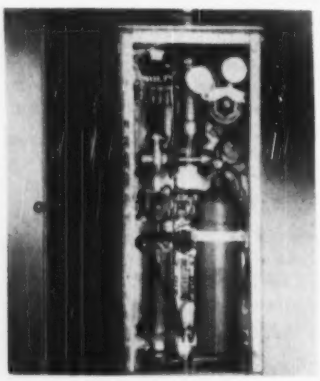

Operating Mechanism

INSTANTLY AVAILABLE pressure of compressed nitrogen is reported to be used in a new automatic operating mechanism to open and close air-break switches. The mechanism is adaptable to sectionalizing transmission lines, disconnecting branch lines, transferring loads from one power source to another. Or variations on these three basic schemes can be made by using standard relays.

Steps in operation of the mechanism are these:

1. Mechanism is energized by a relay or a pushbutton.
2. Main magnetic valve opens.
3. Either opening or closing valve opens simultaneously with main valve.
4. Gas is admitted at one end of the operating cylinder, adjustable needle valves regulating the speed.
5. Limit switches de-energize valves at end of operation and set circuits for next operation. Mechanism may be fitted for manual control.

Manufacturer states that it will not be necessary to change the gas cylinders until after 25 to 30 complete operating cycles. Three sizes of cylinders are available to provide 250, 400, or 500 ft-lb of operating effort. Operating time is 3 sec.

Hi-Voltage Equipment Co, 4000 E. 116th St, Cleveland 5, Ohio

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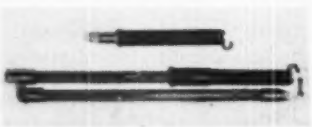

Clampstick

A STRONG steel spring holds the clamp in the recess of the head of the Saf-T-Clampstick. After a clamp is positioned and tightened onto the line, a quarter-turn of the pole locks the clampstick hook in the open position for removal from the eye of the clamp. The clampsticks are available on straight or hinged poles, or in Fit-On design.

James R. Kearney Corp, 4236 Clayton Ave, St. Louis 10, Mo.

•

Hook Ladders

NEW HOOK ladders are available for use by linemen doing construction or maintenance work on towers and H frames. Shank of the hook fits in a two-position locking device. By pushing them down, the hooks can be folded in for ease in transporting. For use on steel towers and plank type crossarms

not over 6 in. wide, 7½-in. hooks are recommended by the company. The 15½-in. hooks are made especially for use on H frame spar arms up to 14 in. diam. However, the hooks are interchangeable on the same ladder. Overall ladder lengths are from 10 ft 8 in. to 13 ft.

Bodendieck Tool Co, 325 E. Main St, Taylorville, Ill.

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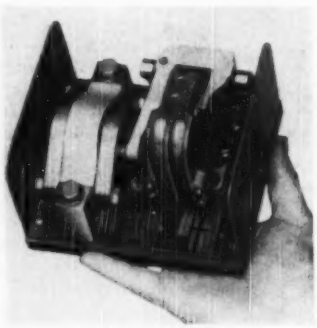

Magnetic Air Valve

ROTARY ACTION is applied in a new magnet-operated air valve that may be used on welding machines or machines powered by compressed air. It is designed as a four-way, four-port ⅜-in. valve for control of a double-acting air cylinder. It can be converted to three-way or two-way operation.

The valve will operate continuously at 300 c per min, and at speeds up to 600 c per min on intermittent duty. Power consumption of the coil is re-

Made to Last

IF there's anything to get hold of, Hubbard 4-11-44's take a grip—and keep it. The screw is sharp pointed for easy starting by hand. The threads are deep, sharp, clean-cut, and the root diameter increases slowly. This gradual taper means easier insertion and a better hold . . . and the threads are cut clear to the base, so that the screw takes a grip in material considerably thinner than the full screw length. The screws are made of galvanized steel. The same wireholder, with different stock numbers, may be obtained, if desired, with non-ferrous and longer screws, toggle bolts, carriage bolts, and stud bolts.

And note the construction of the insulator; tensile strain is taken by metal, the porcelain is subjected to compression strain only. "Metal parts in tension—porcelain parts in compression" has been a principle of Hubbard Wireholder design for more than 35 years. The porcelain is accurately molded to avoid high spots; and the wire bail is sufficiently flexible to adjust itself to the contour of the insulator.

Hubbard 4-11-44 Wireholders far surpass recommended ratings on standard house service conductors. Millions of installations have proven their unfailing dependability.

HUBBARD AND COMPANY

ESTABLISHED 1842

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the load on Hubbard Hardware!"

ported to be 38 va at 60 c and 215 va inrush. Details are in Bulletin 9043-C.

Square D Co, 4041 N. Richards St, Milwaukee 12, Wis.

•

Pole-Setting Derrick

A NEW front-mounted pole-setting derrick, Model FT, is for use with trucks equipped with front-end winches. The main boom is adjustable to four positions, the highest enabling the derrick to handle poles up to 35 ft long and working load up to 1,500 lb. It is made of seamless steel tubing.

Also available is a new ratchet-type front support jack to take the load off the truck and truck springs.

Batavia Metal Products Corp, School St, Batavia, N. Y.

•

Electric Steam Boiler

APPLICATIONS of Model 400 electric steam boilers include process heating of plastic presses, jacketed kettles, pressing machines, degreasers, and other steam-using equipment. This model is built to ASME Code specifications, has a maximum working pressure of 50 psi, and is available in standard sizes from 3 to 25 boiler hp. It can be operated on 220, 440, or 550 v, single or polyphase.

Livingstone Engineering Co, 100 Grove St, Worcester, Mass.

•

Phase Converter

THREE-PHASE 220-v motors can be used on 1-ph 220-v power lines through use of phase converters designed for 3, 5 or 7½ hp motors. Special sizes can be furnished for motors up to 40 hp. Non-fusible toggle switches make separate motor starting controls unnecessary. Fuse blocks containing Fusetrons reportedly eliminate the need for a separate fusible disconnect.

Among benefits of 3-ph equipment said to accrue to the user of this equipment are higher power factor and efficiency, less motor loss and less surge on the line. Farmers and small shop or factory owners in rural and suburban areas will find the phase converter of special interest, according to the manufacturer.

The Henry Electric Co, Saginaw, Mich.

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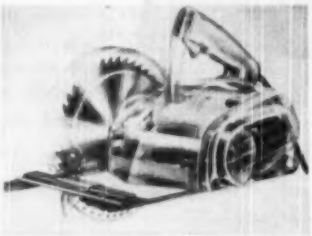


Portable Electric Saw

A DUAL V-belt from the Universal motor shaft to the saw arbor shaft is the method of drive for a new portable electric saw. Saw has a weight of 19 lb, up to 1½ hp are developed, and it is fitted with an 8½-in. blade that has 2 11/16-in. capacity cut. Saw is equipped with an adjustable base for making bevel cuts of from 90 to 45 deg; it is also adjustable for depth of cut.

Syntron Co, 205 Lexington Ave, Homer City, Pa.

•

MORE NEW EQUIPMENT

Just Received

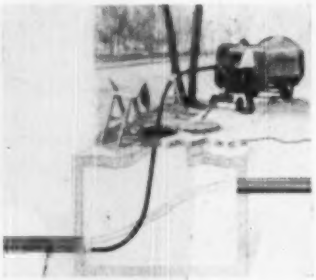
Appearing Next Issue

RELAYS
Temperature and current protection for transformers, circuits

UNDER-VOLTAGE PROTECTION
Allows motor to re-accelerate if voltage recovers in 2 sec

PRESET SPEED DEVICE
Knob sets speed at motor or at end of 15-ft flexible cable

GROUND TESTER
Checks ground resistance to minimize lightning dangers



Rodding Machine

MECHANICAL RODDING of electric and phone ducts can be performed with the Roducter which is said to work at speeds up to 100 fpm, and rod 900 ft in one direction, from one location. The 6-hp engine has gear reduction and twin disk clutch.

With special tools the machine can be used for boring through dirt and debris, fishing out burned off cables, pulling light weight cables, and pulling proving mandrels.

Flexible Sewer-Rod Equipment Co, 9059 Venice Blvd, Los Angeles 34, Cal.

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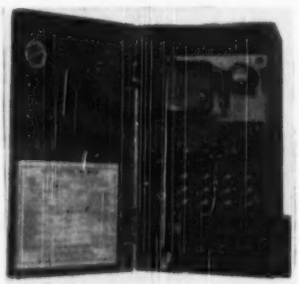


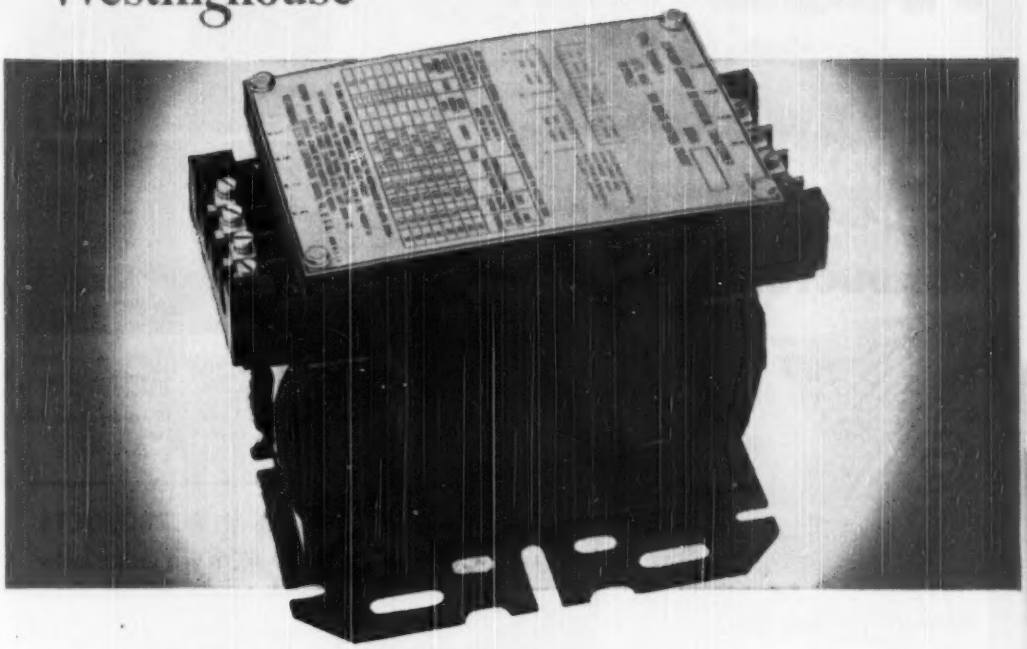
Time Switch

BASIC TYPES of timing incorporated in the Cat. 110 electronic time switch include: Automatic repeat, interval, delayed action, and programming. These are said to become available by changing external connections to the terminal board. Applications include induction heating equipment, conveyors, and electroplating.

Timing periods of 0.05 sec to 4 min with an accuracy variation of under ±2% are said to be obtained with a

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



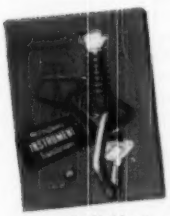
TRANSFORMER

with a Thousand-and-One Uses!

Here's the transformer that eliminates the need for large stocks of auxiliaries.

One type—*available from stock* in nine multi-ratio designs—covers 95% of all auxiliary transformer applications. Used as a current transformer for matching currents of various magnitudes or phase relationships . . . also used as a potential transformer. Special ratios easily obtained by connecting the windings as auto transformers.

Save the cost of maintaining excessive inventories. For specific information on designs available, contact your Westinghouse representative, or write for CS 45-306. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-70566



THE MOST COMPLETE LINE IN THE INDUSTRY

Write for your copy of Booklet B-4319, "Westinghouse Instrument Transformers". Concise, profusely illustrated, with a pictorial cross reference to descriptive literature on the individual transformers that make up the most complete line in the industry.

Westinghouse

INSTRUMENT TRANSFORMERS

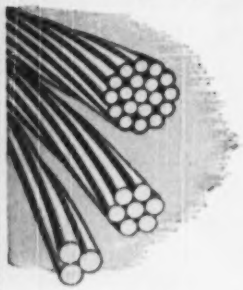
PAGE

Stainless Steel

STRAND

and Stainless-Copper

CONDUCTORS



Here's WHY they Save

Compared with other types strand of equal breaking strength, they . . .

- have 30-40% greater overload capacity within elastic limit
- resist corrosion all the way through —not merely through a thin case of soft metal
- offer highest tensile and vibration-fatigue strength (tensile strength 235,000 psi; corrosion-fatigue limit 50% of ultimate)

Here's HOW they Save

- They permit longer spans—therefore require fewer poles per mile.
- Being lighter, they are easier and faster to install in the field.
- More resistant to destructive factors, they last many times as long before replacement.

Let us tell you the whole story—

specific data, prices, recommended sizes.

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

ACCO

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

selector switch and variable resistor.

Standard units may be had for either 115 or 230-v operation, 50-60 c.

Coral Designs Div, The Henry G. Dietz Co, Box 248, Forest Hills, N. Y.

•

Snap-Action Switches

ADVANTAGES claimed for an expanded line of small, precision, snap-action electrical switches include: (1) rapid, positive snap-action; (2) reduced arcing; (3) no dead center position; (4) double-break contacts that provide two separate circuits.

The standard Electro-Snap switch is a spdt type, designed for ac circuits. Applications include control of solenoid valves and use as limit and safety switches.

The Exhibit Supply Co, Electro-Snap Div, 4218 W. Lake St. Chicago, Ill.

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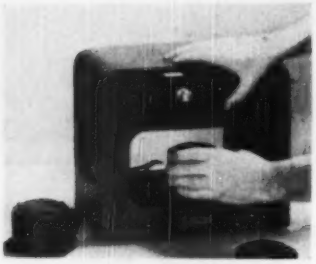


Demagnetizing Coil

ANY UNSHIELDED magnetically soft material, including forms of iron and steel, can be demagnetized by an improved demagnetizing coil, the manufacturer reports. It is useful in equalizing and stabilizing magnetic flux in permanent-magnet assemblies that are used in electrical instruments and control devices.

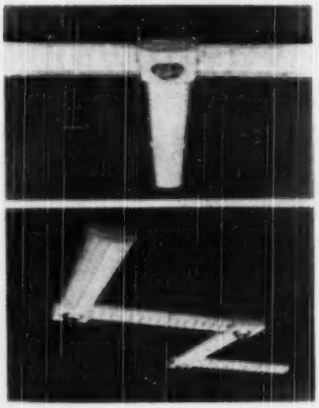
The demagnetizer consists of an air-core coil built in a frame which can be mounted on a table. The coil is rated 115 v, 60 c, and is equipped with switch, pilot lamp, and a flexible lead fitted with a standard plug. It will accommodate stock up to 8 in. wide.

General Electric Co, Apparatus Dept, Schenectady, N. Y.

•

Spotlight Fixtures

SIX NEW incandescent Trimspot spotlight fixtures are reported to match the company's series of 13 shielded fluorescent Trimline fixtures, and give increased flexibility. Each spotlight fixture is equipped with one or two 150-w PAR-38 spot lamps which can be rotated in a 360-deg arc and tilted up to an angle of about 20 deg. These



fixtures allow lighting to follow contours of an area, or be carried around columns.

Sylvania Electric Products, Inc, 60 Boston St, Salem, Mass.

MORE NEW PRODUCTS
about which you should know

AIRCRAFT-MARINE PRODUCTS, INC, 1656 N. 4TH ST, HARRISBURG, PA., is manufacturing a pneumatic **hand tool for crimping** solderless terminals to wire sizes No. 6 to 1/0 Awg. . . . MORGANITE, INC, 3304 48TH AVE, LONG ISLAND CITY 1, N. Y., is producing self-lubricating carbon **bearings** which function at relatively high speeds under heavy loading at temperatures to 800 F.

HUNTER SPRING CO, LANSDALE, PA., is offering the Neg'ator **Clamp** for securing to overhead piping, shelves, and tables to hold wire and heavy power cable clear of electrical equipment and working areas. . . . HAYDON MFG CO, INC, TORRINGTON, CONN., has No. 8006 series interval **timer** for 1, 15, 60 and 180 min; a hold feature is available for battery charger use.

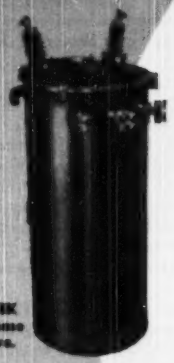
EUTECTIC WELDING ALLOYS CORP, 40 WORTH ST, NEW YORK 13, N. Y., offers EutecRod 1807, a **silver joining alloy** with a remelt temperature of 1850 F, that has an electrical conductivity said to be twice that of conventional silver solders. . . . WESTINGHOUSE LAMP DIV, BLOOMFIELD, N. J., has an improved medium bipin fluorescent **lamp base** said to simplify proper seating.

INGWERSEN MFG CO, 1800 S. ACOMA ST, DENVER, COL., is making a tool, No. 1601, to **cut outer servings** of telephone switchboard cords, and for maintaining such cords. . . . GEDNEY ELEC-

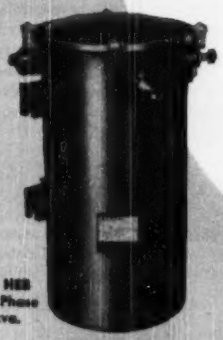
Wagner Distribution Transformers

are Standardized in every rating and design

IN ACCORDANCE WITH E.E.I.—NEMA FOURTH REPORT



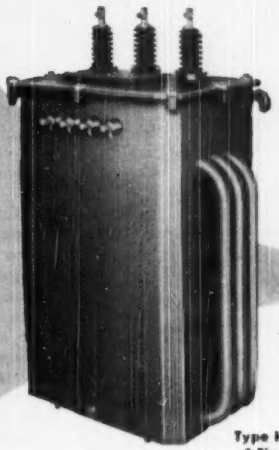
Type HIK
Single Phase
37½ kva.



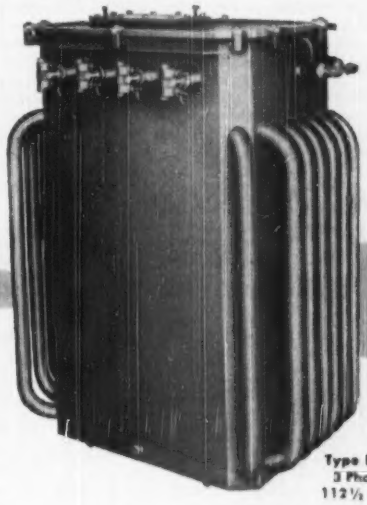
Type HEB
Single Phase
15 kva.

Type HEX
Single Phase
100 kva.

Wagner's complete line of distribution transformers includes every rating and design listed in the E.E.I.—NEMA Fourth Report—no matter what your particular requirements may be . . . there's a Wagner transformer to fit your needs.



Type HPK
3 Phase
45 kva.



Type HPB
3 Phase
112½ kva.

You save time, money and worry when you make your selection from Wagner's widely diversified line of distribution transformers — you get the benefit of Wagner's quality construction, improved design, and high efficiency with *standardized* mechanical features in ratings of 500 kva and below — 15,000 volts and below.

Wagner has a nationwide organization to provide fast, convenient service, with 29 branch offices in principal cities ready to help you with your transformer problems. Bulletins TU-180 and TU-181 give complete information on Wagner Transformers.

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS · TRANSFORMERS · INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 29 PRINCIPAL CITIES

NEW ANTIOXIDANT FOR TRANSFORMER OIL . . .

KOPPERS IMPRUVOL 20

EXTENSIVE laboratory tests indicate that Koppers new liquid inhibitor, Impruvol 20, will greatly extend the useful life of transformer oils. With the addition of as little as .5 to 1.5% of Impruvol 20, the oxidation stability of new oil is increased 5 to 15 times. Similar results are shown with reclaimed oils.

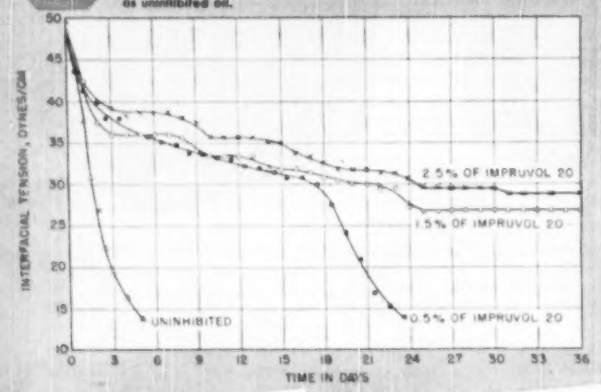
DBPC—the oxidation inhibitor that has been used in turbine oils for many years—is the active ingredient in Impruvol 20. However, the Koppers inhibitor is specially compounded, and is made into an oil solution for easy application to transformer oils. Further, Impruvol 20 will stay in the oil in the presence of water.

Study the tests shown below. They will tell you, better than words, what Impruvol 20 can do. If you are interested in improving the life of your transformer oil, write for Bulletin C-O-140, to Koppers Company, Inc., Chemical Division, Pittsburgh 19, Pa.

KOPPERS COMPANY, INC.
Chemical Division **Pittsburgh 19, Pa.**

KOPPERS

Interfacial Tension values under 95°C Oxidation Tests show Impruvol 20 inhibited oil impressively delayed in oxidation and at no stage as rapid as uninhibited oil.



TESTS ON A RECLAIMED OIL

	Time to Reach Sludge Stage	Increase in Oil Life
Uninhibited	2 days	—
0.5% of Impruvol 20 added	10 days	500%
1.5% of Impruvol 20 added	32 days	1,600%
2.5% of Impruvol 20 added	45 days	2,250%

TESTS ON A NEW OIL

	Time to Reach Sludge Stage	Increase in Oil Life
Uninhibited	5 days	—
0.5% of Impruvol 20 added	23 days	460%
1.5% of Impruvol 20 added	70 days	1,400%

TRIC CO, 1270 SIXTH AVE, NEW YORK, N. Y., has a pull-in **corner elbow** for running conduit around sharp corners without forcing or damaging the wires.

SQUARE D CO, 6060 RIVARD ST, DETROIT, MICH., has announced a new "plug-in" **multi-breaker** panelette as a companion to the NMO panelboard; ratings are 15, 20, 30, 40, or 50 amp. . . . ANALYTICAL MEASUREMENTS, INC, 585 MAIN ST, CHATHAM, N. J., has designed the Analascope which can serve as a **pH meter** up to 0.001 pH, and as a pressure indicator or strain analyzer.

GENERAL ELECTRIC CO, NELA PARK, CLEVELAND 12, OHIO, has developed a 4-w lamp which gives off small amounts of **ozone** which is useful in making the presence of odors less perceptible. . . . WESTON ELECTRICAL INSTRUMENT CORP, 617 FREELINGHUYSEN AVE, NEWARK 5, N. J., has designed the Type E **tachometer generator** for use in explosive atmospheres; available as an ac or a dc generator.

A. G. BUSCH CO, INC, 2632 N. CENTRAL AVE, CHICAGO 39, ILL., is marketing the Safety-Flare **auto light** which illuminates the work and also glows red. It plugs into the car's cigar lighter and an electromagnet holds it on surface of the car.

CLAUDE NEON, INC, 25 W. 43D ST, NEW YORK, N. Y., has announced a new type **servomechanism kit** reportedly capable of solving complex automatic control device problems. Basic high-precision parts are furnished which can be experimentally assembled and reassembled. . . . THE DIAL LIGHT CO OF AMERICA, INC, 900 BROADWAY, NEW YORK 3, N. Y., has available **sockets** of the NE 12 series intended for mounting lamps with double contact bayonet bases, especially for 10C7DC pilot lamp.

IDEAL INDUSTRIES, INC, 1021 PARK AVE, SYCAMORE, ILL., is offering a pocket-size fluorescnt **lamp tester** which locates trouble in the circuit, starter, or tube. . . . ATLAS INDUSTRIAL CORP, 849 29TH ST, BROOKLYN 32, N. Y., has a portable steel **ladder** with working platform which will extend from 4 to 24 ft and can reportedly be set up in less than 7 min.

CENTURY ELECTRIC CO, 1906 PINE ST, ST. LOUIS 3, MO., has designed a fractional hp **motor** of the split phase type for use on oil burners. . . . U-C LITE MFG CO, 1050 W. HUBBARD ST, CHICAGO 22, ILL., is making Model III portable **hand lamp**, powered by a 6-lantern battery, for utility repair crews, plant maintenance and repair, etc.

THIS MAN WOULDN'T NEGLECT

A MACHINE IN HIS PLANT

...yet he hasn't had a Chest X-Ray!

He checks every piece of mechanical equipment he owns for wear, lubrication, efficiency.

Yet he fails to take the simple precaution of a Chest X-Ray to make sure he does not have tuberculosis. *Not because he's opposed to the X-Ray. Simply because he is not sufficiently informed—or just hasn't taken the time and trouble, or does not realize the seriousness of the problem.*

A Chest X-Ray is the first step toward detecting tuberculosis in its early stages. And in its early stages it can be cured with the least loss of time from work.

So, if you're the man above, that one simple reason should make you get your Chest X-Ray—*today*. But listen, see how serious this really is:

Between the ages of 15 and 34, tuberculosis leads all other diseases as a cause of death—although at no age are you safe from TB. Yet, if everyone does his part by getting a Chest X-Ray periodically, and the majority of cases thus discovered are followed up, we can eliminate TB entirely as a public health hazard!

Will you do your part today? Get a Chest X-Ray. It may mean your life!

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Published in the public interest by:

McGRAW-HILL PUBLICATIONS

NEWS ABOUT PEOPLE

Thorgaard Elected Head of North Central Group

E. K. Thorgaard, division manager of Northern States Power Co, St. Cloud, Minn., has been elected president of the North Central Electric Association.

Other officers are George A. Neal, Iowa Public Service Co, vice president,

E. K. THORGAARD

and J. A. Hennessy, Northern States Power, treasurer.

Thorgaard has been with the utility since 1923, when he started as an electrician's helper in the special construction department in Minneapolis. Later he was transferred to the Wisconsin division and worked at Chippewa Falls, Eau Claire, and Cedar Falls on substation installations.

After service in several Minnesota divisions, Thorgaard worked with the lighting sales department in the installation of lighting fixtures at the general office building in Minneapolis. In 1934 he was made traveling lighting sales engineer for the Southwestern and St. Cloud divisions and two years later went to the St. Cloud division as lighting sales engineer. In 1942 he was transferred to the Glenwood district as management representative for the western half of the St. Cloud division. He has been division manager since 1945.

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Charles M. Fife, manager of the Electric Home Bureau of West Penn Power Co, has been named industrial development manager. He succeeds **Walter H. Kelly**, who is retiring after more than 30 years. **Y. L. Ripley**, assistant Electric Home manager, moves up as manager. Fife, organizer of the home bureau, has been with the company for 27 years. Kelly has been active in industrial development work throughout the state.

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Engineering Staff Shifts Made by Westinghouse

Louis R. Botasi has been appointed manager of the Motor and Control Division of Westinghouse Electric Corp. He succeeds Leon R. Ludwig, who has been added to the staff of John K. Hodnette, vice president, in Pittsburgh.

Joseph H. Cox, a pioneer in the field of lightning research and mercury arc rectifier engineering, has been made supervisor of electrical engineering for the Sunnyvale, Calif., Works. He also will have district-wide supervision of quality control in the Western plants.

Botsai has been manager of the Gearing Division in Pittsburgh since 1941. He joined Westinghouse in 1915 and served as general engineer of steel mill electrification at East Pittsburgh, consulting refrigeration engineer, sales engineer, central industrial manager, sales manager of gearing apparatus, and sales manager of the Small Motor Division in Lima, Ohio.

Ludwig has been in charge of operations at the Buffalo plant since it was opened in 1946. Before that he was manager of the Motor Division at East Pittsburgh. In 1940 he was named manager of the circuit breaker and protective devices department and in 1943 manager of the Motor Division.

Cox, who joined the company as a service engineer in New York in 1923, was assigned to lightning and other high voltage and transmission studies. Holder of more than 20 patents, he was responsible for the development and design of the Ignitron rectifier. During World War II he helped to develop vacuum and leak detecting apparatus for the atomic bomb project.

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Alfred V. Coleman has been appointed assistant to the president of New England Electric System. He will be in charge of operation of the retail companies in New Hampshire and Massachusetts except for Fall River Electric Light Co and Attleboro Steam & Electric Co. He has been in the utility field since 1916.

Lastinger New President of Georgia Power & Light

John W. Lastinger, vice president of Georgia Power & Light Co, has been elected president of the wholly owned Florida Power Corp subsidiary. He succeeds J. F. Bailey, who has resigned.

At the same time C. W. Warner, gen-

JOHN W. LASTINGER

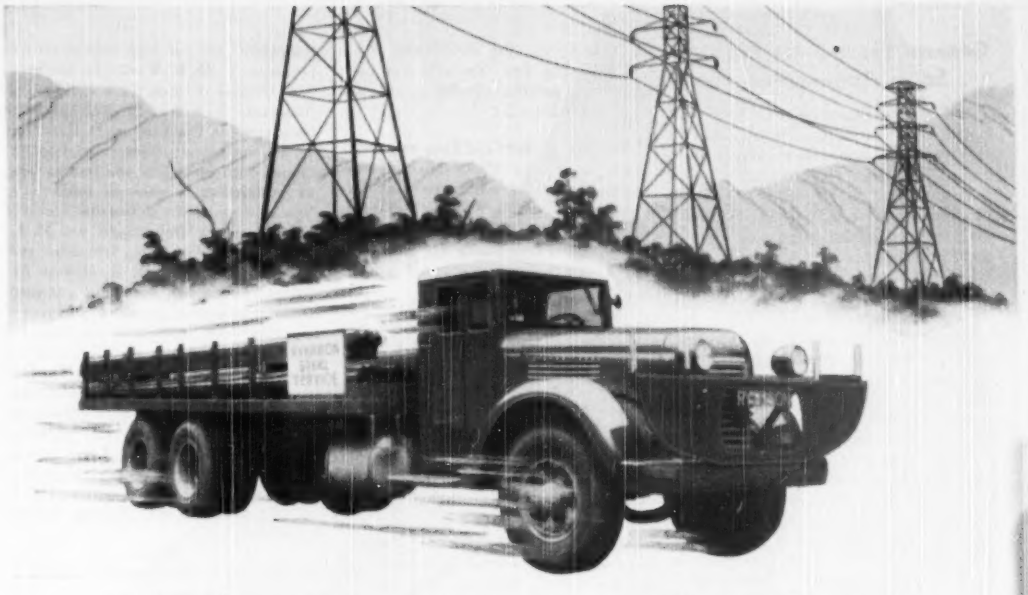
eral superintendent of Georgia P&L, was named a vice president and direc-

C. W. WARNER

tor. Both men will continue to make their headquarters at Valdosta, Ga.

Lastinger has been with the company since 1926 and has served as manager of the Valdosta district. A director for a number of years, he was elected a vice president in 1945.

Warner is a member of the American Institute of Electrical Engineers and a registered professional engineer in Georgia.



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Ryerson Steel Service is keyed to your job—the task of supplying America with power and light. More than a century of service to the utilities and their equipment sources provides Ryerson specialists with the experience required to meet your needs accurately and promptly.

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BARS—Carbon and alloy, hot rolled and cold finished, reinforcing bars, etc.
STRUCTURALS—Channels, angles, beams, etc.
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SHEETS—Hot and cold rolled, many types and coatings
TUBING—Seamless and welded, mechanical and boiler tubes, structural tubing, etc.
STAINLESS—Allegheny sheets, plates, bars, tubes, pipe, pipe fittings, etc.
BABBITT METAL—Ryerson Glyco in 5 grades
MACHINERY & TOOLS—for metal fabrication

RYERSON STEEL

RYERSON CERTIFIED STEELS

JOSEPH T. RYERSON & SON, INC. PLANTS: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI
CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

General Electric Co Fills Sales, Engineering Posts

William E. Herrmann has been appointed manager of sales of the laboratory products section of General Electric Co's Special Products Division at Schenectady, N. Y. He will be in charge of headquarters sales activities for specialized testing and measuring equipment developed and manufactured in GE laboratories.

He replaces Robert R. Person, who has been transferred to the staff of the manager of manufacturing of the company's Large Apparatus Divisions. Herrman was assigned to the division in 1947.

Elbridge G. Dudley and Louis F. Rodewig have been made manager and assistant manager, respectively, of the industrial division of the Apparatus Department's New York district. Dudley has been assistant division manager and Rodewig a division section head.

Dudley joined GE in 1921 and served in turbine sales work in Schenectady and as an industrial division sales engineer. Rodewig, who went to the company in 1922, also has been a division sales engineer and became a section head in 1947.

These sales and engineering appointments also have been reported:

B. W. Mahoney, assistant manager of manufacturing for the Transformer and Allied Product Divisions at Pittsfield, Mass., has been appointed assistant manager of sales for the division. Max I. Alimansky, assistant manager of engineering, was transferred to Mahoney's former position. These "temporary" changes are part of the company's policy of giving executives opportunity to learn more phases of the business.

Charles C. Leader, assistant to the manager of manufacturing of the Control Divisions, has been named staff assistant to the manager of engineering of the Large Apparatus Divisions. James L. McFarland, assistant division engineer in the engineering department of the Schenectady industrial heating divisions, has been appointed manager of engineering of the Industrial Heating Engineering Division.

New manager of the Transportation Divisions in Schenectady is H. W. Gouldthorpe, who has been manager of engineering of the Locomotive and Car Equipment Divisions at Erie, Pa. J. H. Gauss, assistant manager of sales for the Locomotive Divisions, was made sales manager of the Transportation Divisions.

•

Charles H. Goddard will assume responsibility for national accounts sales in the lighting division of Sylvania Electric Products, Inc. He will also continue in his present capacity as manager of utility sales.

Ellsworth C. Cotton has been appointed manager of New Hampshire Electric Cooperative, with headquarters at Plymouth. He succeeds **William H. Grove**, of Washington, D. C. Cotton formerly was superintendent of White Mountain Power Co, recently purchased by the co-op.

Richard D. Saffen has been named employee relations supervisor of Indiana & Michigan Electric Co, with supervision of the utility's personnel training program in its three operating divisions. He has been safety director and employment director.

Daniel J. Webster has been appointed marketing manager of Murray Manufacturing Corp, Brooklyn, N. Y. He will head two newly created sales departments—for engineering sales and distributor sales. Webster, who joined Murray in January, formerly was manager of the distributor section of the agency and specialty sales division of Westinghouse Electric Corp.

Charles G. Vogel has been made superintendent of the electrical departments of the Norwood Works of Allis-Chalmers Manufacturing Co. He started there in 1929 as a tester and has been general foreman of the electrical department since 1943.

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New Assignments

Francis M. Truman has been appointed Cortland district manager of Niagara Mohawk Power Corp. He succeeds **T. F. Federer**, who has retired after 27 years of service with Niagara Mohawk and its predecessors . . . **Gregory J. Kenny, Jr.** has been named distribution engineer in the operating department of Florida Power Corp. He has been assistant engineer at Ocala . . . **John R. Kelly** has been made general superintendent of Gainesville, Fla., utilities. Other appointments include **Joe E. Cox** as superintendent of electric and water distribution and **R. G. Crosby**, as superintendent of the electric plant . . . **W. H. Clagett, Jr.** who has been with the Bureau of Reclamation at Grand Coulee Dam for 14 years, has been transferred to the chief engineer's office of the bureau at Denver, Colo. At Grand Coulee he was in the concrete control section, directed research projects, was engaged in installation and inspection of high voltage equipment, and was in charge of efficiency tests for generators and development tests for high voltage circuit breakers . . . **H. E. West**, who has been New Orleans division sales manager of Anaconda Wire & Cable Co, has been transferred to Washington, D. C., where he will coordinate sales promotion activities with electrical contractors and wholesalers on a national basis . . . New staff assistants in General Electric Co's Apparatus Department are **M. L. Hurni**, Large Apparatus Divisions, and **Hershner Cross**, Small Apparatus Divisions. Hurni has been staff assistant to the distribution transformer division superintendent, and Cross has been on the GE management research staff at Princton, N. J. . . . **A. Norman Murray** has been appointed regional planning engineer for the Bureau of Reclamation at Sacramento, Calif. He replaces **Stanley A. Kerr**, who has retired. Murray has been in charge of engineering phases of the bureau's water rights investigations in the Central Valley since 1949.

OBITUARY

Dr Charles M. Allen, 78, director of the Alden Hydraulic Laboratory of Worcester Polytechnic Institute, died at Holden, Mass., Aug 15. He was the originator of the salt velocity method of measuring water flow in streams, pipes, and channels, involving electrical conductivity indications related to time, and was active in the use of scale models of flood control and hydroelectric structures and in prime mover testing. He had been on the faculty of Worcester Tech since 1895 and also was known as a consulting engineer. Allen held a number of medals from engineering societies and during both world wars carried on research projects for the armed forces.

A. B. Smith, 55, assistant manager of the engineering department of the National Electrical Manufacturers Association, died Aug 16. He had been with NEMA since 1930. He started in 1916 on the test course of Westinghouse Electric Corp, spent a year with the United Electric & Power Co (now Consolidated Edison), and then joined the Underwriters' Laboratories, Inc, as assistant electrical engineer. He was a member of the American Institute of Electrical Engineers.

Thomas J. Stiverson, vice president and treasurer of Columbus & Southern Ohio Electric Co, Columbus, since 1948, died Aug 5. He had been with the utility for more than 30 years and had been treasurer since 1935.

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BUT ROCKBESTOS A.V.C.® IS 43% SMALLER

With higher-rated A.V.C. and a 390 ampere load INSTALLED COSTS ARE LOWER*—

- **you use a 400 MCM cable *not* 700 MCM**
- **you use 3" conduit *not* 3½"**
- **you use *smaller* fittings and lugs**
- **you have *lower labor costs* because smaller, lighter cable and conduit are quicker and easier to handle.**

Size for size A.V.C. has a HIGHER AMPERE RATING

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... YOUR BEST BUY

Permanently-insulated Rockbestos A.V.C. can save you money. Write for the booklet "Cut Current Carrying Costs."

*Comparison with Type RH based on Chapter X—National Electrical Code, 60°C-104°F Ambient

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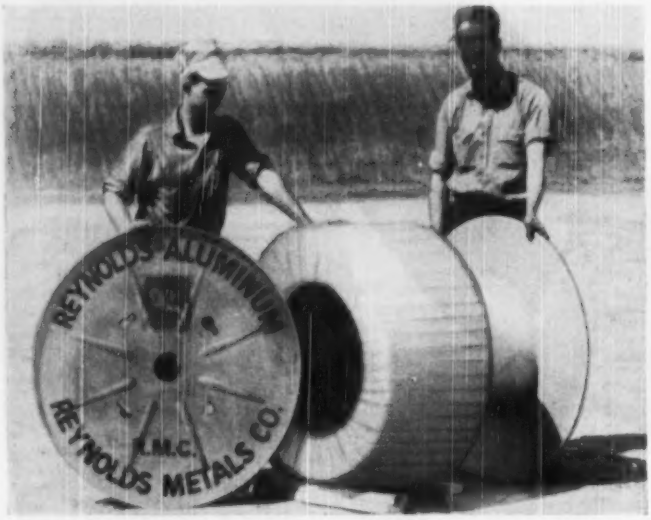
MANUFACTURERS and MARKETS



SAVING of about ½¢ a lb for users of aluminum transmission cable is claimed for Reynolds Metals Co's new packaging method. Coils are shipped without customary wood reel, then assembled in the field on a metal master reel (above) kept by the cable user. Method eliminates expense of returning reels and reel breakage. In shipping coil is protected by heavy cardboard core and end plates, a paper wrap, and overall wood lagging

Allocation Machinery Likely Soon to Control Tight Aluminum Supplies

MACHINERY to allocate domestic supplies of aluminum is expected to be set up soon after President Truman signs the Defense Production Act of 1950. Conservation export controls may come even sooner.

Stockpiling, new uses and defense production are the main reasons why Washington will be forced to ration the metal. The $7.7-billion military aircraft construction program will squeeze already tight supplies.

Essential users can be sure of getting all they need as fast as they need it. But others won't be so lucky, despite impressive plans to expand primary aluminum production.

Production of some civilian lines may have to be dropped completely once the aircraft industry hits its stride. Scratchpad estimates put this year's military bite at 260 million lb, or close to 20% of U. S. production at the current rate. Fiscal 1952's (July 1, 1951 to June 30, 1952) will be bigger.

Here, in brief, is how the aluminum picture shapes up today:

U. S. primary aluminum production exceeds 1,300 million lb a year.

Consumption is running close to 1,500 million lb. Imports from Canada make up most of the difference.

Even so, demand exceeds supply. Primary producers have been rationing their customers for weeks.

Aluminum rolling mills, extrusion presses, and fabricators are handling a record business but could double their present volume in an emergency.

Expansion plans now under consideration will add 200 million lb a year by the end of fiscal 1951, raising total U. S. production to the World War II peak rate of 1,500 million lb.

By using high-cost steam-electric power—which would mean higher cost aluminum—still another 115 million lb could be wrung out of present facilities.

Chances are Alcan (Aluminum Co of Canada) can hike its production and exports to the U. S.

Even so there probably won't be enough to go around. For two years now the stockpile has been taking at least 50 million lb a year; the 260-million lb figure for fiscal 1951 is just a starter. Civilian consumption will keep on rising (if producers can get the aluminum). And as other Atlantic Pact nations start their mobilization under the Military Defense Assistance Program, essential U. S. exports are expected to rise, not fall.

Control Machinery Wanted

All this adds up to controls unless the defense effort is to suffer. Actually, controls probably won't be really necessary for at least six months, but the signs point to establishment of the machinery for them within a matter of weeks. Washington wants its finger on things, just in case.

Biggest boost in production hinges around the Munitions Board's sale of potlines and rectifiers from the defense reserve plants at Riverbank, Calif., and Burlington, N. J., to private industry (EW, Aug 21, p 27).

This will bring two new primary producers into the field, disperse production facilities to four widely separated cheap-power locations instead of the present two high-power-cost areas, save the government the $15 million it would have cost to reactivate the two plants, and make the plant buildings available for other productive uses.

Massena Plant a Possibility

Another 115 million lb could be added to current production by keeping Alcoa's 1903-built reduction plant at Massena, N. Y., in production. Alcoa recently bought from the government a war-built 120-million-lb-a-year plant nearby and plans to shut down the old Massena potlines as soon as the new ones start producing.

Recently, nearby utilities told officials they could supply enough power to run the extra plant. Trouble is their power probably would cost almost twice as much as the cheaper St. Lawrence hydroelectric power. That means it will take some kind of subsidy to keep Alcoa's Massena plant going. One plan:

Chemical Brush Control with a

WALLOP!

ESTERON BRUSH KILLER

Yes, Esteron Brush Killer packs a wallop! This hard-hitting Dow formulation (4 pounds acid equivalent per gallon) now contains more powerful type esters of 2,4-D and 2,4,5-T—effective on a wider variety of brush and weeds and *much less* volatile than materials previously available. Easy and economical to use, Esteron Brush Killer gives good control of alder, ash, birch, brambles, cherry, elm, hickory, maple, oaks, osage orange, poison ivy, sumac, willow and other hard-to-kill species. It is effective also in controlling resprouting of stumps when it is applied in oil immediately following cutting.

A wealth of information on clearance and maintenance of right-of-ways and vegetation control around substations, pole yards, booster stations and along fence rows is yours on request. Dow sales and technical men are available for consultation and assistance.

Agricultural Chemical Division

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

Also recommended for woody plant control is Esteron 245. For controlling grasses such as Johnson, quack and Bermuda—use Dow Sodium TCA 90%. No fire hazard—and treated foliage will not poison grazing cattle. Ask your dealer or write direct.

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INDISPENSABLE TO INDUSTRY AND AGRICULTURE

USE DEPENDABLE DOW AGRICULTURAL CHEMICAL PRODUCTS

WEED AND GRASS KILLERS • INSECTICIDES • FUNGICIDES
SEED PROTECTANT • PLANT GROWTH REGULATORS
GRAIN AND SOIL FUMIGANTS • WOOD PRESERVATIVE

ALUMINUM

FOR SERVICE DROP WIRES FROM POLE TO HOUSE

Copper is scarce . . . copper is costly! If copper shortages are delaying your installations, now's the time to consider COLLYER ALUMINUM. It's available *now*, and it's low in cost!

EXAMPLE:

Collyer #4 solid HD aluminum conductor neoprene covered has current carrying capacity equal to #6 solid copper TB weatherproof, but in substantial quantities sells for 30% less!

Improved methods of connecting aluminum to copper make installation fast and dependable. A new Collyer bulletin on the technique and devices recommended for connecting aluminum to existing copper conductors is now on the press. Write for your copy today! For information and samples address Collyer Insulated Wire Co., 245 Roosevelt Ave., Pawtucket, R. I.

CHOOSE *Collyer*

Let the government pay Alcoa to operate the plant for stockpiling purposes.

Other plans for raising North American aluminum production are both long-range and costly. They depend primarily on the availability of large sources of cheap power.

Both Alcoa and Alcan have been investigating the feasibility of tapping Alaska's and Canada's great western sources of hydro power.

Each plan, however, would cost in the vicinity of $500 million and take years to complete. The only other possibilities are construction of new plants and cheap power supplies at home or production from present sources of high cost, steam-plant power.

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Metal Prices Still Rising as Supplies Get Tighter

Metals prices continued to climb in the week ended Aug. 21. Supplies of copper, lead, zinc, and tin tightened still more, driving up scrap prices and quotations in secondary markets.

Lead was up 2¢, to 14¢ a lb. Copper held at 22½¢, though rates as high as 28¢ were reported on the gray market. Discouraged about prospects for an end of the 2¢-a-lb import duty, copper fabricators threatened to pass the tariff costs along to buyers. Tin slumped during the week but came back to end still closer to its record high at $1.07 a lb. Steel scrap jumped from $41 to $45 and $46 a ton.

Metal Prices
Aug. 21, 1950

COPPER, Conn. V., lb	$ 22½
LEAD, N. Y., lb	14
ZINC, prime Western, E. St. Louis, lb	15
TIN, Straits spot, N. Y., lb	1.07
ALUMINUM, base price	17½
NICKEL, base price	48
STEEL billets, Pitts., ton	53.00
STEEL scrap, No. 1 heavy, Pitts., ton	45-46.00

SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co. Milwaukee, has assigned John J. Greagan, Jr. to the Charlotte district office as a sales representative.

REPRESENTATIVES

Baker Industrial Truck Division, Baker-Raulang Co, Cleveland, has chosen two new sales representatives. Dillon Scale & Equipment Co, 3907 Elm St, Dallas 1, Texas, will serve all that state except the southeast portion. Henry S. Haight, Haight Engineering Co, Court Square, Charlottesville, Va., will represent the company in the central portion of Virginia.

Larkin Transformers, Pine Bluff, Ark., has named George B. Foss, 1028 14th Ave North, St. Petersburg, Fla., sales representative in the Florida area.

How to read with your eyes open for Business!

Read the ads! Every issue of this magazine contains ads that offer valuable services and useful products by which your business may be run more profitably.

The time it takes to read all the ads is time well spent. One ad alone can pay off—by informing you of new developments and new sources of supply, by helping you do a more efficient job. For example, you may locate one machine that will cut your production costs, or step up your output. Or you may discover that the equipment you've been waiting for is now available.

This magazine displays more ideas and merchandise than a trade exposition. Make every issue your buyers' guide. Read the ads as well as the articles. That's reading with your eyes open for business.

McGRAW-HILL
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DO BOTH WITH

New 250-watt WELLER GUN

You'll save on tools and time with the new Weller Soldering Gun WD-250. Whether the job is rugged or delicate, your Weller Gun does it with the same ease and efficiency. Chisel-shaped RIGID-TIP provides more soldering area for faster heat transfer. New "over-and-under" terminal design gives bracing action to tip. Your Weller Gun is light-weight and compact, gets into the tightest spots.

Weller Guns actually pay for themselves in a few months. Fast 5-second heating saves time on every job. Trigger-switch control saves power—no need to unplug gun between jobs. Prefocused spotlight and longer length mean easy soldering, even when the job's buried deep. No other soldering tool gives you so many time-and-money-saving features. Order your new 250-watt Weller Gun from your distributor today, or write for bulletin direct.

SOLDERING GUIDE Get your copy of "SOLDERING TIPS"—new fully illustrated 20 page booklet of practical soldering suggestions. Price 10c at your distributor's or order direct.

WELLER MANUFACTURING COMPANY

817 Packer Street, Easton, Pa.

NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona—California—Nevada — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing del. f.o.b. cars shipping point or f.o.b. cars Boulder City, Nev., relays and control equip. for cubicles for Units A-3, A-4 and A-9, unmounted control equip. for main control board, for main control terminal board addn. for 3 unit auxiliary control boards for Units A-3, A-4 and A-9, and unmounted relays and equip. for one Arizona-Nevada-Switchyard relay board for Hoover Power Plant, Boulder Canyon Proj. Spec. 3154. L. N. McClellan, ch. engr.

California—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnish del. f.o.b. shipping point or f.o.b. cars Redding, Sacramento and Friant, equipment for Shasta Power Plant for radio relay stations on Bass Mountain, on Grapevine Pass on Mount Oso, Sacramento, Tracy, Fraint Dam, Fresno, Bear Mountain, Orange Dove, Lindsay and transmitter-receiver assemblies for Central Valley Proj. Spec. 3153. L. N. McClellan, ch. engr.

Calif., Stockton—State Div. Architecture, P. Wks. Bldg., Sacramento, refrigeration plant and butcher shop at Stockton State Hospital, Anson Boyd, state archt.

Ill., Bloomington—City, City Hall, general imprvs., exten, municipal electrical sys, $3,816,000. Alvord, Burdick & Howson, 20 N. Wacker St., Chicago, consult. engrs.

Ill., Carmi—City, municipal bldg., incl. reconstr. power sys. $275,000.

Ia., Laurens—Bd. Trustees, Municipal Electric Light & Power Plant, Laurens, bldg. changes, generating equip., switchboard, etc. $75,000. Buell & Winter, 508 Insurance Bldg., Sioux City, engrs.

Kansas—N. C. K. Electric Co-operative, Inc., Glenn B. Snapp, pres., Belleville, 230.6 mi. rural distr. lines in Clay, Cloud, Jewell, Republic and Washington Counties, Proj. Kansas 29 G Republic. Plans deposit $10. Raymond H. Reed & Co., 2305½ 13 St., Columbus, engrs.

Kan., Kansas City—Bd. P. Utilities, Contr. 213, power imprvs., power piping for new turbo-generator sys. Burns & McDonnell Eng. Co., 99 and Troost Sts., Kansas City, Mo., engrs.

Ky., Louisville—Louisville Gas & Electric Co., 311 W. Chestnut St., 60,000 kw. steam electric generating unit at Paddy Run Station on Ohio River. $9,000,000.

Ky., Owensboro—General Electric Co., Radio Tube Div., Owensboro, 4 story, 100x250 ft. brick, stainless steel addns. mfg. plant. $2,000,000. Marr & Holman, Stahlman Bldg., Nashville, Tenn., engrs. and archts.

Missouri—Intercounty Electric Co-operative Assn., Licking, 268 mi. rural distr. lines to serve 716 rural consumers, two-way radio communication sys., headquarters facilities and sys. imprvs., Mo. 18 U. Texas. $600,000.

Nebraska—Panhandle Rural Electric Membership Assn., Alliance, 62.14 mi. rural distr. lines, in Box Butte, Grant and Sheridan Counties. $70,000. Raymond H. Reed & Co., Columbus, engrs.

New Mexico—Bureau Reclamation Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., lightning arresters for Albuquerque sub-station, L. N. McClellan.

N. Y., Idlewild—The Port of New York Auth., 111 8 Ave., New York, Zone 11, 10 story, steel permanent control tower to replace present inadequate temporary tower at New York International Airport. $735,000.

N. Y., Niagara Falls—C. W. Collison, acting city mgr., City Hall, (a) constr. traffic control tower, (b) installing electric utilities, interior wiring, etc., (c) installing all mechanical utilities, incl. plumbing, heating, etc. and (d) high intensity lighting sys. and controllable wind

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F-25

tee at Niagara Falls Municipal Airport. Plans deposit 20.

North Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Washburn and Bismarck, 1 control board for Washburn Sub-station and one for Bismarck Sub-station, Spec. 3152. L. N. McClellan, Denver, ch. engr.

Oklahoma—Cimarron Electric Co-operative, Kingfisher, 110 mi. rural distr. lines, remodeling headquarters facilities. **$145,000.**

R. I., Warwick—State Purch. Agt., State House, Smith St., Providence, installing underground and surface electrical facilities and appurtenant work at Theodore Francis Green Airport. Plans deposit $25.

South Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 1, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars at Oral, S. D., one distribution board, Angostura Power Plant, Cheyenne Div., Angostura Unit, Missouri River Basin Proj. Spec. 3142. L. N. McClellan, ch. engr.

Texas—Kimble Electric Co-operative, Junction, 135 mi. rural distr. lines, Edwards Co. $175,000. Plans deposit $25. J. H. Flood & Co., 2906 Franklin Ave., Waco, engrs.

Tex., Beaumont—Gulf States Utilities Co., Beaumont, addnl. underground ducts, carrying circuits supply service to business section. **$250,000.**

Virginia—S. Eng., foot of Front St., Norfolk, furnishing 14,000/17,500 KVA three phase power transformer for Philpott Reservoir Proj., Smith River, Serial No. CIVENG-44-110-51-5.

Washington—Bureau of Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Othello, two 9x9 ft. head radial gates and two motor-operated gates hoist and controls, incl. hoist dials excluding transmitters and appurtenant parts for Potholes East Canal Headworks, Columbia Basin Proj., Spec. 3158. L. N. McClellan, Denver, ch. engr.

Low Bidders & Contracts Awarded

Fla., River Junction—Gulf Power Co., Pensacola, 50,000 hp. steam-electric generating plant. Owner builds. **$4,000,000.**

Ill., Chicago—University of Illinois Medical Center Comn., West Side Medical Center, Zone 12, design and construction 80x124 ft. 76 high steel brick steam-electric generating plant to Stone & Webster Engr. Co., 33 S. Clarke St., Zone 2, **$4,000,000.**

Mass., Westboro—Commonwealth of Mass., Youth Service Bd., 14 Somerset St., power plant and imprvs., from Ostrov Electric Co., 117 Mechanic St., Worcester. **$108,525.**

Miss., Sweatt—Mississippi Power Co., c/o contractor, superstructure steam electric generating plant, to L. B. Priester & Sons, 1403 12 Ave., Meridian. **$200,000.** Awarded 8/3.

Tex., Brady—City, City Hall, imprv. electric light plant, Purchase and Hire. **$75,000.** Jos. E. Ward, 545 Nacol Bldg., Wichita Falls, engr.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

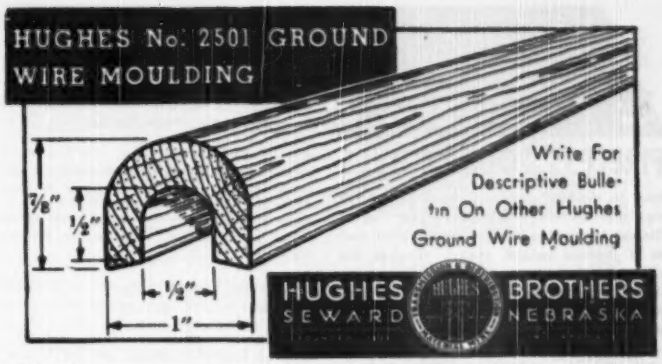
Calif., Los Angeles—Bank of America, 650 S. Spring St., plans by Raymond Shaw, 649 S. Olive St., 13 story bank and office, Wilshire Blvd. and Vermont Ave. **$5,000,000.** Wm. D. Coffey, 649 S. Olive St., consult. engr.

Ill., Skokie—Marshall Field & Co., 111 N. State St., Chicago, plans by James A. Wares, c/o owner, shopping center, incl. large dept store, tunnel for trucks, smaller shops, etc. **$12,000,000.**

Ind., Indianapolis—Chrysler Corp., 341 Massachusetts Ave., Detroit 31, Mich., plans by Albert Kahn Assoc. Architects & Engineers, Inc., 215 New Center Bldg., Detroit, Mich., 1 story, 650,000 sq. ft. brick, structural steel automobile transmission sys. mfg. plant, on 150 acre site. **$7,000,000.**

Mass., East Boston—Port of Boston Auth., Commonwealth Pier, South Boston, re-constr. terminal. **$7,500,000.** Fay, Spofford & Thorndike, 11 Beacon St., Boston, consult engrs.

Miss., Jackson—City, voted bonds, school imprvs. **$8,500,000.**



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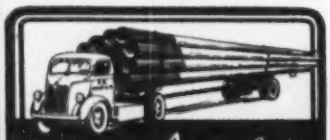

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● POLE LINE TOOLS: Among pole line construction tools described in Catalog No. 50 are: Wire grips, tackle blocks, digging tools, pike poles, peavies, cant hooks, carrying hooks, warning signs, tamping bars, long handle shovels, wire stringing blocks, pole supports, tree trimmers, duct rods, pay-out and take-up reels. Dicke Tool Co, 1201 Warren Ave, Downers Grove, Ill.

● MOTOR APPLICATION: A pictorial presentation of 70 applications of the company's motors has been compiled from a wide cross section of U. S. industry. Sterling Electric Motors, Inc, 5401 Anaheim-Telegraph Rd, Los Angeles 22, Cal.

● CONNECTING LINKAGE: Information necessary for choosing and ordering the correct material and arrangement of control connecting linkage is presented in a 16-page brochure, CA 942. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

● FHP MOTORS: Over 200 specifications to fit almost any fractional hp requirement are listed in a new catalog. Bodine Electric Co, 2254 W. Ohio St, Chicago 12, Ill.

● HYDRAULIC TURBINES: A 56-page booklet covers design and construction of Francis, propeller, and impulse type hydraulic turbines and auxiliaries such as pressure regulators, special high head valves, butterfly valves, and cabinet type governors for large units. Many installations of all three types of turbines are illustrated. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

● PROTECTIVE COATINGS: Information for selection of protective coatings against different corrosive materials, solvents and abrasion appears in Bulletin 7-1. The Atlas Mineral Products Co, 41 Walnut St, Mertztown, Pa.

● LIGHTING: "Your Lighting Simplified" presents information to be considered when purchasing fluorescent lamps—including information about maintenance and fixture quality. The Edwin F. Guth Co, 2615 Washington Blvd, St. Louis 3, Mo.

● INDUCTION MOTORS: "ARMA Induction Motors and Generators", 16 pages, covers 15 types of motors and generators, including 5 new types, for instrumentation and control work. Arma Corp, 254 36th St, Brooklyn 32, N. Y.

● DC POWER SUPPLY: The Varicell is introduced in a broadside which describes its use for providing "stabilized and regulated variable dc voltage from ac power lines." Output is 0-30 v, 15 amp. R. F. Greene, The Superior Electric Co, Hannon Ave, Bristol, Conn.

● F LIGHTING: Twelve new catalog sheets are available which complete coverage of the Plexoline system of fluorescent lighting. Many types of troffers, as well as accent units, are listed. Day-Brite Lighting Inc, 5411 Bulwer Ave, St. Louis 7, Mo.

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Replacement Cost

(*Continued from page 73*)

we adopt the *level* annual charge, the computations become interminable.

Operations and Maintenance . . . It is frequently stated, as though it were axiomatic, that maintenance costs increase with age; but this generality must be viewed with suspicion. Neglecting the effect of price levels, the reverse may be discovered for many types of utility plant, particularly in a growing business.

It is also unwise to jump to the conclusion that old equipment, capable of continued use if repaired, cannot justify the cost of repairs owing to its age alone, and the fact that it has been greatly depreciated on the books. Actually, when a proposed repair or rebuild would postpone purchase of a new replacement, surprisingly large expenditures for repairs may be justified, regardless of "book value."

Normal annual maintenance and operating expense can usually be forecast by a review of past experience, as a level dollars per year. Occasionally, such expense may be correlated with age. Unusual charges, such as a major repair that is non-recurring, should be included only in the year when they occur. Very often, in these problems, such charges are the unknown, the objective being to determine the maximum amount that could be spent and still break even.

Example

Following example illustrates the application of the foregoing procedure.

A watthour meter now 25 years old cost $9, installed. Its modern replacement would cost $13, installed. If the old meter were retired today, it would bring $2 net salvage; if retained in service, its remaining life is estimated at 15 years (normal expectancy at age 25 if average life is 30 years, Iowa type S_0 dispersion), and ultimate net salvage would be zero. It is estimated that underregistration of the old meter would amount to $0.25 annually over its remaining life, and that its maintenance would cost $.50 per year more than for the new replacement. Should it be replaced?

(*Continued on page 140*)

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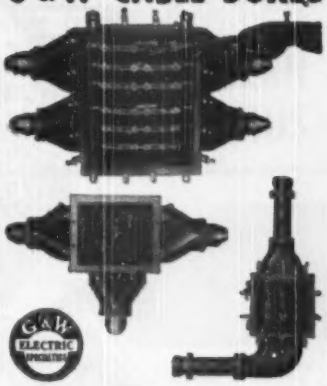

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(Continued from page 139)

If replaced immediately, annual costs on the new meter would amount to $1.45 per year except in the first year, when they would be reduced by reason of the $2 net salvage on the old meter. This estimate is obtained as follows:

1. Return. At 6% of $13 = $0.78 per year.

2. Depreciation. Estimated average life 35 years type S_0 dispersion, zero net salvage, annual rate per Table 3 = 1.51% of $13 = $0.20 per year.

3. Federal Income Tax. Assuming continuance of present 38% tax, 50-50 ratio of bonds to stocks, 4% interest rate on bonds, tax = 2.45% of $13 = 0.32 per year.

4. Taxes on Gross Receipts. Estimated at 12% of gross receipts (ie, 12% of items 1+2+3) = $0.15 per year.

5. Total Annual Costs: $0.78+0.20+0.32+0.15 = $1.45 per year.

Credit for immediate salvage value of the old meter, allowing for effect on gross receipts tax = 1.12 × $2 = $2.24.

These figures are tabulated in Table 4, Column 5.

If the old meter is kept in service, annual return and depreciation expense will continue to be incurred throughout the remainder of its life. The present worth of these future charges is exactly equal to the write-off of remaining value that occurs if it were retired immediately and replaced: hence, these charges may be omitted from both tabulations.

However, if retained, taxes, maintenance expense, and the costs of under-registration would be incurred on the old meter, as follows:

6. Federal Income Tax. At 2.45%, as above, of $9 = $0.22 per year.

7. Maintenance and Under-Registration. At ($0.50 + $0.25 =) $0.75 per year.

8. Taxes on Gross Receipts. At 12% of items 6+7 = $0.12 per year.

Thus, total costs per old meter will be $1.09 per year. But only in the first year will they be applied to 100% of an old meter; in every successive year they apply to the fractional survivors of the *average* meter, per Table 1, Column 2. The products of $1.09 multiplied by these percent survivors appear in Table 4, Column 3.

In addition to the above charges, annual costs of the gradual replacement by new meters are incurred. The number of replacements in each year are obtained from Table 1, Column 4; they are multiplied by their annual cost ($1.45 per year, derived replaced immediately, will be the above), and the products tabulated in Table 4, Column 3. Thus, total annual costs if the old meter is not

replaced immediately, will be the figures of Table 4, Column 4.

The increase in annual costs resulting from the replacement appear in Column 6 (=Col. 5 less Col. 4). The present worth of these differences appears in the final column, which indicates a saving of $0.85 by keeping the old meter in service.

Comments . . . Computation of Table 4, once the method is understood, represents perhaps 3 hours' work, which seems considerable for the sake of $0.85. But applied to 1,000 meters, it represents $850, or $283 per hour, as well as avoidance of an unwise immediate capital expenditure of $13,000. Applied to a substation transformer the saving might be $10,000, instead of $0.85 per unit.

An Approximate Solution . . . As indicated in Fig 3, an approximate short-cut solution may be obtained by assuming that each one of the old units, if not replaced immediately, would serve for the average expectancy. In such case, keeping the old meter in service would mean annual costs of $1.09 per year for 15 years.

If replaced immediately, annual costs of the new meter would be $1.45 per year for 15 years, as above. In addition, there would be the credit of $2.24, immediately, for salvage value of the old meter including its effect on taxes.

Accordingly, the net saving by not replacing the old meter would be $0.36 annually for 15 years, less the immediate credit of $2.24, or:

1. The present worth of $0.36 per year for 15 years, at 6% (=$0.36×9.712249)	=$3.50
2. Less credit for salvage value of old meter, including effect on taxes (=$2×1.12)	= 2.24
Saving by retaining old meter	=$1.26

Because this solution slightly overrates the remaining service capabilities of the existing plant, it exaggerates the savings obtainable by retaining it in service ($1.26 versus $0.85). Under some circumstances the discrepancy may be less than in this case, and acceptable as being within the accuracy of estimate. When considering replacement of a single item which is the only one of its kind owned by the company, there seems to be no alternative to this method of estimate. Ordinarily, however, such short-cuts must be used with caution.

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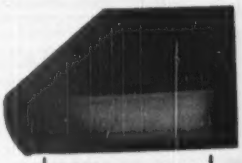

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(Classified Advertising)

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NEW ADVERTISEMENTS received in the New York City office by Sept 1st will appear in the Sept 11th issue subject to limitations of space available.

THE AUSTIN COMPANY

Invites Applications from Capable Electrical Engineers and Draftsmen

Opportunities are being offered to Engineers and Draftsmen who can design and/or prepare engineering drawings for industrial buildings and their facilities. Assignments are not for specific projects but are in our regular engineering staffs in long-established offices, located on the East Coast, Central West, Gulf Coast, and West Coast. Good working conditions. Established vacation and sick leave plans, also paid holidays.

Positions are open to men possessing a sound background of education and experience qualifying in—

POWER WIRING A.C. AND D.C.—INDUSTRIAL ILLUMINATION
POWER DISTRIBUTION — CONTROLS —
ELECTRONIC APPLICATIONS

Full particulars as to education, experience, and compensation desired should be given in first letter.

NATIONAL HEADQUARTERS

16112 EUCLID AVENUE CLEVELAND 12, OHIO

PROJECT ENGINEER

Wanted — Experienced Construction Engineer for large turbo-generator power plant on East Coast. Must have recent experience in directing operations for complete projects with knowledge of sub-aqueous operations and construction of docks and waterfront facilities. Write giving full particulars of education, experience and salary expected.

P-7107, Electrical World
330 W. 42nd St., New York 18, N. Y.

ELECTRICAL ENGINEERS

Graduates, experienced in design engineering and economic studies of steam-electric power plants and high voltage substations. Also, knowledge of power system relaying and preparation of specifications for switchboards and switchgear.

P-7545, Electrical World
330 W. 42nd St., New York 18, N. Y.

RIGHT OF WAY MEN

for Mid-Atlantic Electric Company. Experience in purchasing transmission rights of way essential. Applicants please give age, education and experience record.

P-7457, Electrical World
330 West 42nd Street
New York 18, N. Y.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED, SEVERAL engineering graduates, under 35, by large industrial fire prevention organization, for field work involving periodic inspections and special consulting service. Electrical and chemical engineers preferred. Permanent. Openings in United States and Canada. P-7354, Electrical World.

ELECTRICAL POWER Plant Designer-Draftsmen wanted. Experience in electrical control design and planning desirable. Location South Atlantic States. P-7455, Electrical World.

POSITION VACANT

GENERAL MANAGER for small, established Central N. Y. State concern, manufacturing Auto Electrical and Ignition Parts as well as Industrial Electrical Parts and Assemblies. Prefer applicant with background of engineering and production experience. Reply stating age, education, experience, marital status, salary desired, etc. This is an unusual opportunity in a progressive firm. Reply P-7520, Electrical World.

EMPLOYMENT SERVICES

SALARIED POSITIONS $1,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service. (40 years recognized standing and reputation). The procedure of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

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POSITIONS WANTED

MANAGER OR Engineer—Age 42 thoroughly experienced Distribution and trans. line construction and maint. Diesel Elect. and Steam Elect. station management. Operation and Maint. PW-6861, Electrical World.

ELECTRICAL ENGINEER. Registered, age 36. 8 years experience R&A Transmission, distribution, and municipal system design and construction. Full responsibility. Desire position with future. PW-7481, Electrical World.

SYSTEM OPERATOR: 25 years experience in Fundamental Engineering and Operating Practice pertaining to System Operation, Load Dispatching, Interconnected Operation, Power Pool Operation, etc. Employed but desire to locate in south or southwest — Married, two children. PW-7482, Electrical World.

U. S. Government

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Specifications No. 3146) will be received by Bureau of Reclamation, Denver, Colorado, September 19, 1950, and then publicly opened for furnishing five 230,000/196,000-volt, 1,000-ampere, 10,000,000-kva, outdoor power circuit breakers, with disconnecting devices on both sides of each of 3 breakers only for Grand Coulee 230-kilovolt switchyards, Columbia Basin Project, Washington. Delivery is desired within 300 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.

MICHAEL W. STRAUS, Commissioner.
(100)

AVAILABLE

ELECTRICAL SUPT. MANAGER

Technical Education, plus 5 years high voltage power plants, 1 year Radio-Electronics, 5 years automatic process control instruments, 10 years Electrical Supt. of Construction-Maintenance.
Large industrial plant. Now employed. Want position with responsibility which will justify $10,000 to $15,000 per year.

PW-7501, Electrical World
330 W. 42nd St., New York 18, N. Y.

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It is our only means of identifying the advertisement you are answering.

TRANSFORMERS

FOR SALE

1-Phase, 60 cycles

3—1000 KVA A-Ch 13800—2400
3— 500 KVA W-H 13200—240/480
3— 500 KVA G-E 11500—2300/4000Y
3— 333 KVA G-E 23000—2300/4000Y
3— 333 KVA G-E 13800—120/240
3— 333 KVA G-E 11000—2300/4000Y
3— 333 KVA Wag 4600—115/230
4— 200 KVA Kuhl 33000—3400

3-phase, 60 cycles

1—1000 KVA Wag 6900—575
3— 750 KVA W-H 13800—480 Dry Type
1— 150 KVA Penn 33000-2300
1— 150 KVA Penn 22000/11000-2300

Many other items in stock

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Reliable rewind and repair services on all makes of transformers.

THE ELECTRIC SERVICE CO.

CINCINNATI 27, OHIO

FOR SALE

The following described Generator Unit, as is, where is. Price—$3750.00.

NORDBERG HIGH EFFICIENCY ENGINE

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Nordberg Mfg. Co.
Milwaukee, Wisc.

Complete with jet condenser, steam pressure 170 to 220 pounds. Direct connected to

ALTERNATING CURRENT GENERATOR

No. 600153
P.F. 0.8

Type ATI 48-480-150 Form E, KW 320, Volts 2300, Amps 100, Speed 150—Mfg. General Elec. Co. This includes electric panel.

For additional information address

C. R. ODOM, CITY MANAGER,
P. O. BOX 710 BARTOW, FLORIDA

FOR SALE:

General Electric 2 speed motor, model 5K444NN1, frame 444, 220-60-3, 28/10 H.P., 1160/580 R.P.M. Totally enclosed, fan cooled. New—present owner cannot use. $375 f.o.b. New York for quick sale.

FS-7544, Electrical World
330 W. 42nd St., New York 18, N. Y.

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No lengths too long or too short

Telephone: Eastgate 7-4778

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2670 Clybourne Ave. Chicago 14, Illinois

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TURBO GENERATORS

Qu	KW	Make	Desc.
2	750	G.E.	Condensing—250 lbs. I.S.P. 440 v. 3 ph. 60 cy—Built 1944
1	625	Westg.	Non-cond. 125 lbs. I.S.P., 5/20 lbs. B. P.-4 Boy 3 ph. 60 cyc.
1	400	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.
1	300	Whse.	Non-condensing—125/150 lbs. I.S.P. 5/10 lbs. B.P.—240/480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

	KVA	Make	Type	Volts	Speed
1	5140	Whse.		2400/4150	600
1	4000	G.E.	TSC	2400/4150	900
1	3000	Whse.		2400/4800	720

MOTOR GENERATOR SETS
3 ph. 60 cy.

Qu	KW	Make	Speed	DC Volts	AC Volts
1	1000	G.E.	450	125/250	2300/4150
1	1500	G.E.	360	275	2300/4600
1	1500	G.E.	900	600	2300/4150
1	1250	G.E.	600	600	4150
1	1250	G.E.	600	600	4150
1	1000	Whse.	900	600	4150
1	1000	G.E.	720	250	2300/13200
1	750	Whse.	900	275	2300/415

TRANSFORMERS—60 Cycle

K	Make	Type	Ph	Voltages
3—2666	Whse.	OISC	1	66000x11000
1—2000	Al. Ch.	OISC	1	13200x2300
1—2000	Pack.	AT	3	13800x2300
3—1250	G.E.	HVDDJ	1	66000x2300
1—1000	Pitts.	OISC	1	12200-2300
1—600	Al. Ch.	OISC	3	2300/4150x230/440
3— 333	Pitts.	OISC	1	70600x3800

FREQUENCY CHANGERS

1— 800 KW A. C. 25/60 cy. 11000/3300 v

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OFFICE & SHOP
51 Howell St., Jersey City 6, N. J.

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IMMEDIATE SHIPMENT

UNIT CAPACITIES—10 TO 1875 KVA
A.C.—50 AND 60 CYCLES
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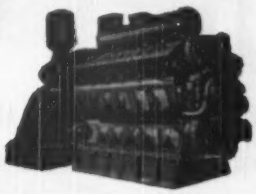


A PARTIAL LISTING OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1875	Fairbanks Morse	38TF16	2600	720	275	Enterprise	DSC-6	440	450
1420	Fairbanks Morse	38D8⅛	1600	720	250	Superior	KNA	400	514
1250	General Motors	16-278A	1600	720	212	General Motors	6-268A	440	1200
937.5	General Motors	12-567	1080	720	213	Clark	MD-4	275	857
625	Alco	6-12½x12T	720	600	187	Ingersoll Rand	6	225	514
425	Baldwin	VO-6	510	450	156	General Motors	3-268A	160	1200
400 2	Buckeye	80	480	600	75	General Motors	6045C	90	1200

D.C. UNITS ALSO AVAILABLE

A. G. SCHOONMAKER COMPANY, INC.

ENGINE DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

SLIP RING MOTORS
1—2300 HP G.E. MT 257 RPM 900V
1— 500 HP G.E. MT 705 RPM 2200 V 4150

SYNCHRONOUS CONDENSER
1—2500 KVA Whse 720 RPM 2200 V with D.C. Exc.

MOTOR GENERATORS
1—1000 KW G.E. 600 V 514 RPM 2200/4000 V
1— 500 KW G.E. 275 V 900 RPM 4150 Volt
2— 150 KW G.E. 125/250 V 1200 RPM 4150 Volt
1— 100 KW El. Mach. 1200 RPM 125/4150 Sys.

TRANSFORMERS
1—3000 KVA Amer. 3 Ph. 27,000V, 2300V.
1—2000 KVA G.E. 3 Ph. 27,000V 2300V
1—1500 KVA G.E. 3 Ph. 4150 V 2300 Pyranol
1—1000 KVA G.E. 3 Ph. 4150 V 2400 V
1—1000 G.E. 3 Ph. 4150 2 Ph. 2400 V
1— 500 KVA Kuhlman 1 Ph. 4150 V, 2300 V
1— 400 KVA G.E. 6900 2300 V Sec.
1— 100 KVA G.E. 4150-240/480 V Pyranol
1— 75 KVA G.E. 2400-240/480 V
1— 75 KVA Whse 2300-230/115

Complete Line of A.C. and D.C. Motors and Generators

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

MOTORS, GENERATORS, TRANSFORMERS
1 – 1500 H.P.
Bought and Sold
New and Rebuilt
ELECTRIC EQUIPMENT CO
ROCHESTER 1, N. Y.

ELECTRICAL CABLE

- for every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular supplier.
- Cut to length. Reasonably priced.

UNIVERSAL Wire and Cable Co.
2870 N. Clybourn Ave., Chicago 14, Ill.

Midnight snack that pays off in pork chops

FEED hogs at midnight?—One farmer does, and finds it pays. He fills troughs, then wakens swine with floodlights. Soon they are greedily enjoying their "snack." When lights go out, the animals retire—to grow pork chops while they sleep! Odd?—Perhaps; but this is one more example of the uses for electricity on the farm!

With rural electrification, comes the need for efficient pole-line insulation. Hemingray Power Insulators have answered this need with complete dependability.

No. 680 for 15,000 volt lines. The technical standards committee of the Rural Electrification Administration has approved Hemingray Insulators No. 670, No. 680 and No. 514 under the limits of AIEE Specification No. 41-1944 for use on REA lines.

HEMINGRAY
POWER INSULATORS

American Structural Products Company
Muncie, Indiana
Subsidiary of Owens-Illinois Glass Company

LETTERS TO THE EDITOR

Aerial Distribution Cable

To the Editor of ELECTRICAL WORLD:

In your issue of August 13th, 1949, p 98, you described a 15-kv aerial power distribution cable with varnished cambric insulation under a polyvinyl chloride jacket. As we are considering a similar installation for a bridge crossing we would much appreciate your letting us know where other cables of this type are in operation in the U.S.A. or Canada, together with the name of the operating company, if possible.

E. T. Alward
Engineer
Electrical & Mechanical Section
Public Works Department
City of Montreal

(Editor's Note: Mr. Alward refers to the article "Aerial Cable Improves Industrial Service" which describes an aerial cable system for 15-kv primary power in two chemical plants in Texas. ELECTRICAL WORLD is publishing this letter in the hope that other power companies who have made such an installation will contact Mr. Alward.)

Engineering a Profession?

To the Editor of ELECTRICAL WORLD:

It seems to me that the address of Mr. J. F. Fairman as outgoing AIEE President held at Pasadena last June (printed in *Electrical Engineering*, Vol. 69, 1950, July issue, pp 579-582) deserves wider publicity than *Electrical Engineering* can give. Some of his conclusions are so self evident and still so often violated that they deserve citation: "Specifically, let us not use the titled 'engineer' in any form for people who are not engineers or for positions which do not require engineering training or experience. Let us not assign engineers to jobs which are not engineering. Then let us pay salaries to those in real engineering positions commensurate with their individual training, experience and ability and let us treat them as we would LIKE TO BE TREATED, both in our economic and professional relationships. Let us be sure that we put our professional ideals into practice in our own offices and shops."

We all know that Fairman means exactly what he says, and that he in his own sphere of influence acts accordingly. However, there are too many in similar influential positions who "preach water and drink wine" in matters of professional recognition, and they are the ones who need the education which the reading of Fairman's address will provide.

Eric T. B. Gross
Professor of Power
Systems Engineering
Illinois Institute of Technology
Chicago, Ill.

(Editor's Note: ELECTRICAL WORLD is pleased to present Prof. Gross' comments and to open this forum to the views and observations of others concerning the important and timely subject of the professional status of engineers.)

No Delay In Service

To the Editor of ELECTRICAL WORLD:

In your July 24 issue on page 11 in commenting upon electric house heating in the South, the article comments upon the number of homes heated electrically in Chattanooga, the receipt of 250 applications per month and then goes on, "Nashville expects to have 13,000 electric heating customers by December 31, 1951. City officials report there is no delay in getting this service as generally has been the case in Chattanooga. . . ."

The impression created is that generally there is delay in getting electric heating in Chattanooga, which is not a correct statement of the conditions. We think we have been reasonably prompt in connecting, by the time they are ready to use it, people who desire electric heat and certainly "generally" is not the correct term to use in describing any delays which have occurred in Chattanooga. . . .

S. R. Finely
General Superintendent
Electric Power Board of Chattanooga
Chattanooga, Tennessee

(Editor's Note: ELECTRICAL WORLD regrets the unfortunate use of the word "generally" in the above mentioned item and any resulting reflection upon the service rendered by the Chattanooga utility.)

INDEX TO ADVERTISERS
Page 143

Your Best Buy

THE

"MK-40"

The Standard of Comparison

Universal acceptance by operating engineers is abundant proof of the sound engineering principle incorporated in the design.

Its simplified construction and improved high pressure contacts at both ends of the blade insure the highest mechanical and electrical performance under the most severe weather and service conditions.

You can select a Delta-Star group-operated "MK-40" switch for every type of service, from 7.5 thru 230-kv and current ratings to 5000 amperes.

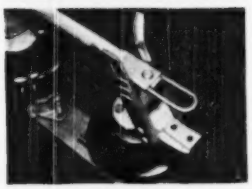
Delta-Star 69-kv. 600 amp. "MK-40" air switch

CURRENT PATH

From terminal to terminal the number of current interchange surfaces is reduced to an absolute minimum. Both ends of the floating tubular blade have the same type of reliable high pressure contacts backed by independent pressure applying members. There are no other moving contact surfaces or springs. Everything is in plain view for visual inspection.

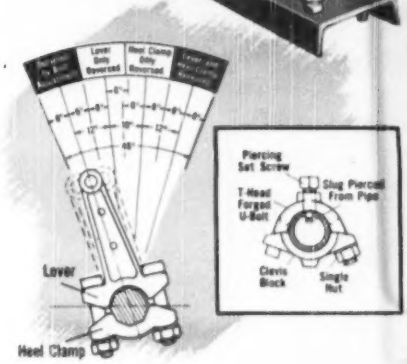
BLADE MECHANISM

Fully controlled blade is actuated by a 45-degree bearing mechanism which replaces cranks, levers, links and cams. It converts motion of operating insulator to a vertical lifting and rotating motion of the blade, with a smooth sequence and just the right mechanical advantage. Blade locks automatically in both opened and closed positions.



CONTACTS

Current carrying function of the contacts is independent of the pressure applying members to take full advantage of the electrical and mechanical characteristics of the materials used. Hard drawn copper shoes have heavy silver inlays. Ample material for heat dissipation assures high thermal conductivity. Uniform contact pressure is maintained by long, beryllium copper springs which carry no current.



OPERATING MECHANISM

Switch and control bearings have greaseless non-rusting ball bearings—insure free operation under all weather conditions. Self-piercing set screws on clamp type U-bolt fittings eliminate threading and drilling of pipe. Completely adjustable lever can be installed or removed without disturbing rotating insulator.

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHES SPECIFY THE "MK-40"

DELTA-STAR ELECTRIC COMPANY

MAIN OFFICE AND FACTORY—2400 Block, Fulton St., Chicago 12, Ill.
NEW YORK OFFICE—110 Cedar St., New York 6, N. Y.

DISTRICT REPRESENTATIVES IN THE FOLLOWING CITIES

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Los Angeles, Cal.
Minneapolis, Minn.
Norfolk, Nebr.
Norfolk, Va.
Philadelphia, Pa.
Pittsburgh, Pa.
Richmond, Va.
Roanoke, Va.
St. Louis, Mo.
San Francisco, Cal.
Seattle, Wash.
Tampa, Fla.
Washington, D. C.
Honolulu, Hawaii

CANADIAN ASSOCIATE

Canadian Line Materials Limited — Toronto 13, Canada

Young turbine with a bright future . . .

OFFICIALS of a midwest power company have every reason to believe that their new 40,000-KW turbine, shown above, will never have to be shut down for oil replacement, oil system cleaning, or because of oil acidity troubles. Their convictions are based on their own experience with Nonpareil Turbine Oil.

Since 1940, this company has put Nonpareil Turbine Oil into five big turbines, including the new unit. These five turbines have a total capacity of 188,500 KW. During the *one to nine years of operation* on Nonpareil, neutralization numbers have stayed below .06 mg. KOH/gm. There have been no time losses or troubles caused by high acidity. Oil systems have not required cleaning. Such benefits are assured this company, not only for 8 or 10 years, but for the *life* of its turbines. This assurance is based on Nonpareil's written guarantee that it will maintain a neutralization number below 0.15 mg. KOH/gm.

Why not end oil system maintenance and oil-acidity troubles, once and for all, by using Nonpareil Turbine Oil in your turbines? For more evidence of these savings, ask a Standard Oil Lubrication Engineer to supply you data from 20-year service records of Nonpareil Turbine Oil.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY (INDIANA) STANDARD